Vol. 11, No. 20
October 31, 1986

Energy Research Abstracts

Abstracts 45587-47141

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Office of Scientific and Technical Information; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $72.00 for domestic (North America) or $90.00 for foreign (outside North America) subscribers; a single issue is $5.00 or $6.25, respectively.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available (use PB86-946800) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual price is $18.00 for domestic (North America) or $36.00 for foreign (outside North America); a single issue is $9.00 or $18.00, respectively.

Energy Meetings (EM)

A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB86-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $45.00 for domestic subscribers and $90.00 for subscribers outside the North American continent; a single issue is $5.00 and $10.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription price (12 issues plus cumulative index) is $85.00 for domestic (North America) and $170.00 for foreign (outside North America) subscribers; a single issue is $8.00 and $16.00, respectively.

Current Energy Patents (CEP)–**PB86-902800.** International patent literature, including patent applications, on any aspect of energy production, conservation, and utilization.

Energy and the Environment (EAE)–**PB86-914900.** Impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

Fossil Energy Update (FEU)–**PB86-914600.** The exploration, development, processing, and use of fossil fuels.

Fusion Energy Update (CFU)–**PB86-915300.** Information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

Solar Energy Update (SEU)–**PB86-914500.** The utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $45.00 for domestic (North America) and $90.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

Acid Precipitation (APC)–**PB86-901000.** Acid precipitation, including effects and possible control measures.

Buildings Energy Conservation (BEC)–**PB86-900700.** Technology required for energy conservation in buildings of all types.

Coal-Based Synfuels (CBS)–**PB86-901400.** Conversion of coal into gaseous or liquid fuels.

Coal Combustion and Utilization (CCU)–**PB86-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

Coal Preparation and Pollution Control (CPC)–**PB86-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

Direct Energy Conversion (DEC)–**PB86-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

Energy from Biomass (EFB)–**PB86-900600.** Biomass production, conversion, and utilization for energy.

Geothermal Energy Technology (GET)–**PB86-914700.** Exploration, development, and utilization of geothermal resources.

Heavy-Ion Reactions (HIR)–**PB86-900500.** Heavy-ion (A > 4) reactions.

Laser Research (LAR)–**PB86-901100.** Laser research and development, excluding applications.

Nuclear Fuel Cycle (NFC)–**PB86-913400.** Both front and back ends of the nuclear fuel cycle.

Nuclear Reactor Safety (NRS)–**PB86-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

Radioactive Waste Management (RWM)–**PB86-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

Solar Thermal Energy Technology (STT)–**PB86-901200.** Research and development of efficient and reliable solar thermal conversion systems.

Transportation Energy Research (TER)–**PB86-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

Unconventional Petroleum (UCP)–**PB86-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, OSTI builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to OSTI's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of OSTI's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Office of Scientific and Technical Information has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications; OSTI also serves as adviser for special publication needs of the Department. To effectively manage DOE's technical information resources, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

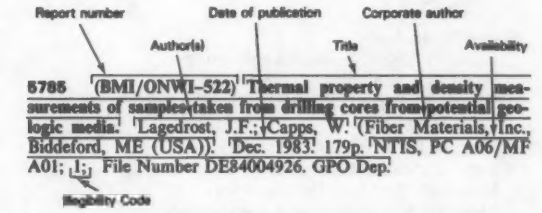
ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00675-3 and the price is $124.00 for the Vol. 10 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

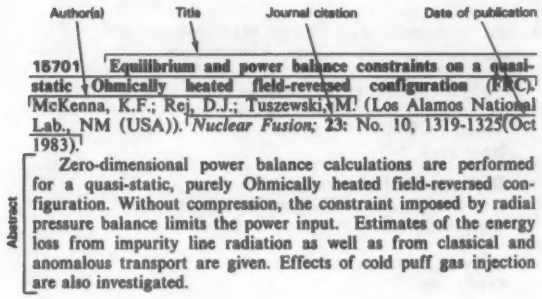
Office of Scientific and Technical Information
United States Department of Energy, P. O. Box 62, Oak Ridge, TN 37831

HOW TO USE *ENERGY RESEARCH ABSTRACTS*

ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.
Legibility Code
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J:US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Foreign Sources

CEA Centre d'Etudes de Saclay
GIF-sur Yvette Cedex, France

Fachinformationszentrum
Energie, Physik, Mathematik GmbH
Karlsruhe, Federal Republic of Germany

IEA Biomass Conversion Service
Dublin, Ireland

IEA Coal Research
Technical Information Service
London, England

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National Aeronautics and Space Administration
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NOVA Information Services Company
Commack, NY

Plenum Publishing Corporation
New York, NY

University of Tennessee
Graduate School of Library and Information Sciences
Knoxville, TN

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 39 first-level and 286 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

45587 (ORNL/FMP—86/2) AR and TD Fossil Energy Materials Program. Quarterly progress report for the period ending March 31, 1986. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 447p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE86014333.

The objective of the AR & TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The management of the Program has been decentralized to the DOE Oak Ridge Operations Office (ORO) and the Oak Ridge National Laboratory (ORNL) as technical support contractor. The ORNL Fossil Energy Materials Program Office compiles and issues this combined quarterly progress report from camera-ready copies submitted by each of the participating subcontractor organizations. It is the intent of the AR & TD Fossil Energy Materials Program to sponsor materials research which is generic to a number of fossil energy technologies. It is hoped that this series of AR & TD Fossil Energy Materials Program quarterly progress reports will aid in the dissemination of information developed on the program.

0104 Processing

REFER ALSO TO CITATION(S) 45622, 45630, 45633, 45634, 46317

45588 (BNL—38255) Effect of non-reacting gases on the flash methanolysis of coal. Mikesell, P.C.; Chandavarkar, A.S.; Rahaman, R.S. (Brookhaven National Lab., Upton, NY (USA); Massachusetts Inst. of Tech., Brookhaven, NY (USA). School of Chemical Engineering Practice-Brookhaven Station). Aug 1985. Contract AC02-76CH00016. 56p. (MIT/BNL—85-3). NTIS, PC A04/MF A01; GPO Dep. File Number DE86014126.

The effects of system pressure, coal particle size, helium and nitrogen concentration in the feed gas, and methane to coal feed ratio on the yields of ethylene and benzen-toluene-xylene (BTX) in the flash methanolysis of coal were investigated. Experiments were conducted in an 8-foot long, 1-inch diameter entrained downflow tubular reactor. Higher ethylene yields were observed at a lower pressure, a smaller coal particle size, and higher methane to coal ratios. Any effect of the addition of nitrogen or helium to the feed gas on ethylene yield was masked by the standard error involved in the experimental procedure. None of the variables studied has a significant effect on BTX yields. The flash methanolysis process is transport limited and not equilibrium controlled. The overall process is exothermic; the heat of reaction correlates with the ratio of methane converted to coal converted. A preliminary economic analysis indicates that the process is not currently viable. 26 refs., 10 figs., 24 tabs.

45589 (CONF-860608—7) Mechanical properties and corrosion behavior of structural ceramics exposed to coal gasification environments. Hobday, J.M.; Easler, T.E. (Argonne National Lab., IL (USA); USDOE Morgantown Energy Technology Center, WV). Apr 1986. Contract W-31-109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014558.

From World congress on high tech ceramics: electronic, engineering, nuclear, biomedical research and applications in focus; Milan, Italy (23 Jun 1986).

Applications of structural ceramics in coal conversion systems are discussed in an overview of the US Department of Energy's (DOE) research program on structural ceramics. Specifically emphasized is DOE-sponsored work at Argonne National Laboratory (ANL) evaluating the corrosion behavior and changes in mechanical properties of structural ceramics (sintered alpha silicon carbide, siliconized silicon carbide) after exposure to simulated coal gasification environments at 1000 to 1300°C for periods up to 500 h, with and without coal slag coatings. Results on the effects of exposing ceramics with and without slag coatings to higher oxygen partial pressures (i.e., combustion environments) will be compared to those for low oxygen partial pressures (coal gasification environments) to emphasize the influence of environment on corrosion behavior and mechanical properties. 8 refs., 5 figs., 4 tabs.

45590 (DOE/FE/60181—2084) Kinetics of catalyzed steam gasification of low-rank coals to produce hydrogen. Final report for the period ending March 31, 1986. Galegher, S.J.; Timpe, R.C.; Willson, W.G.; Farnum, S.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 41p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014268.

The principal goal of coal char-steam gasification research at the University of North Dakota Energy Research Center (UNDERC) is to establish the feasibility of low-rank coal gasification for hydrogen production. The program has focused on determining reaction conditions for maximum product gas hydrogen content and on evaluating process kinetics with and without catalyst addition. The high inherent reactivity of lignites and subbituminous coals, compared to coals of higher rank, make them the probable choice for use in steam gasification. An extensive matrix of char-steam gasification tests was performed in a laboratory-scale thermogravimetric analyzer (TGA) at temperatures of 700°, 750°, and 800°C. Four low-rank coals and one bituminous coal were included in the TGA test matrix. Catalysts screened in the study included K_2CO_3, Na_2CO_3, trona, nahcolite, sunflower hull ash, and lignite ash. Results showed uncatalyzed North Dakota and Texas lignites to be slightly more reactive than a Wyoming subbituminous coal, and 8 to 10 times more reactive than an Illinois bituminous coal. Several catalysts that substantially improved low-rank coal steam gasification rates included pure and mineral (trona and nahcolite) alkali carbonates. The reactivity observed when using trona and nahcolite to catalyze the steam gasification was the highest, at nearly 3.5 times that without catalysts. The use of these inexpensive, naturally-occurring alkalis as gasification catalysts may result in elimination of the need for catalyst recovery in the hydrogen-from-coal process, thereby simplifying operation and improving process economics. The study included evaluations of temperature and catalyst loading effects, coal and catalyst screening, and determinations of the apparent activation energies of the steam gasification reaction. 11 refs., 23 figs., 9 tabs.

45591 (DOE/FE/60181—2085) Low-rank coal liquefaction mechanisms. Final report for the period ending March 31, 1986. Willson, W.G.; Farnum, S.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014269.

The study of high-severity liquefaction carried out at UNDERC using Big Brown Texas lignite demonstrated the viability of natural abundance ^2H NMR spectroscopy for the study of coal conversion reactions, particularly H-transfer chemistry. Several observations were made that indicated that further investigations in this area would be fruitful. They are: (1) differences in natural abundance ^2H NMR distributions resulted from differences in the processing history of the samples; and (2) the addition of small

amounts of H-donor to a liquefaction reaction changed the natural abundance ^2H NMR distribution with respect to an identical run without added donor. The ^1H and ^{13}C distribution were unchanged. These observations mean that the history of a sample could be compared with that of another sample and that the H-donor history may be deduced from the comparative data. Some mechanistic and kinetic information was obtained from high-severity liquefaction reactions with labeled syngas ($^2H_2/CO$ and $H_2/^{13}CO$). Tests made with $^2H_2/CO$ showed product incorporation of ^2H to be greater than 270 times the natural abundance level as determined by standard addition ^2H NMR spectroscopy and the ^2H distribution was not the same as in the unlabeled test. ^2H entered all fractions of the product during the test including the distillate alkanes, phenols and polars, H_2O, and soluble vacuum bottoms. Polars and H_2O were the most enriched fractions, due to relatively easy H-exchange. There was a distinct isotope effect on the yield as processing with $^2H_2/CO$ resulted in decreased conversion to THF solubles when compared with the identical test with $^1H_2/CO$. 22 refs., 2 figs., 7 tabs.

45592 (DOE/FE/60181—2086) Low-rank coal liquefaction solvent effects. Final report for the period ending March 31, 1986. Willson, W.G.; Farnum, S.A. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014280.

Several areas of research pertaining to solvent effects on low-rank coal liquefaction were investigated. A set of three direct liquefaction experiments were carried out in the UNDERC continuous process unit under the conditions shown by previous experiments to give the highest distillate yield. Each experiment was carried through at least 40 four-hour yield periods before it was terminated, to provide samples of process-derived "lined-out" recycle solvent and equilibrium samples of coal-derived products. Two coals, a North Dakota lignite and a Wyoming subbituminous coal, were compared in the same solvent, and the North Dakota lignite was processed in two very different solvents. The processing conditions were kept at the same nominal values throughout the three runs. The two start-up solvents were chosen because they differ in several important ways. The PDU solvent contained about seven times as much total alkane content and ten times as much n-alkane content than did the A04 solvent. The PDU solvent also contained a higher concentration of methylated and other alkylated aromatic hydrocarbons than A04. These differences in composition are expected to affect the solvating power of the solvent toward the coal and coal-derived products. The difference in reactive nature of the solvents at high temperature and pressure is expected to lead to different initial products. One of the objectives of this set of experiments was to determine whether these differences would affect the composition of the products at line-out. Another goal of the experiments was to assess the differences in the operability, yield, and nature of the products when two different low-rank coals were liquefied with the same start-up solvent. 25 refs., 22 figs., 6 tabs.

45593 (DOE/FE/60181—2087) ChemCoal Process CPU recycle development program with Indian Head lignite. Final report for the period ending March 31, 1986. Willson, W.G.; Knudson, C.L.; Farnum, S.A.; Cisney, S.; Ness, R.; Rindt, J.R.; Porter, C.R.; Brolick, H.J. (North Dakota Univ., Grand Forks (USA). Energy Research Center; Carbon Resources, Inc., Wheat Ridge, CO (USA)). Jun 1986. Contract FC21-83FE60181. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014270.

The ChemCoal Process uses a chemical method to separate ash and sulfur compounds from the organic matrix of coal. The chemical method is an ionic reaction between the phenolic solvent, alkali, coal, and a reductant such as carbon monoxide. The combination of phenolics and alkali act as a good physical solvation medium for the organics in the coal. When heated to between 325° to 340°C at pressures below 12.4 MPa (1800 psig), the organic matrix of the coal is broken down by the reactions of the phenolics and alkali and carbon monoxide to produce lower molecular weight material which is dissolved in the organic solvent. The ash and mineral matter from the coal remain as suspended solids in the aqueous phase. These solid inorganic impurities are removed by centrifugation and filtration, leaving an organic liquid low in ash and sulfur. Distillation is used to recover recycle solvent, a light chemical fraction, and to produce the solid ChemCoal fuel product. This recycle test was primarily aimed at resolving potential process flaws identified in a 1985 report by Bechtel Group, Inc., "ChemCoal Process Evaluation Study." The recycle results showed: excess solvent (113%) was generated under all conditions; no loss in conversion as process derived solvent replaced startup solvent in multiple recycles; reductant consumption was below 2.0 wt % of the maf coal as hydrogen gas; conversion remained relatively constant; ChemCoal process conversion averaged over 80% of maf coal; alkali recovery using the partitioning solvent was greater than 62 wt %; and processing energy requirements were reduced. Based on the successful completion of this program and the elimination of identified potential flaws, UNDERC supports a recommendation for the further development of the ChemCoal Process. 5 refs., 70 figs., 19 tabs.

45594 (DOE/FE/60181—2095) Supercritical solvent extraction. Final report for the period ending March 31, 1986. Swanson, M.L.; Olson, E.S.; Diehl, J.W. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014278.

Supercritical solvent extraction (SCSE) has been performed at the University of North Dakota Energy Research Center (UNDERC) using a semicontinuous extraction system. Extractions were performed using low-rank coals and supercritical solvents which included water, methanol, and various hydrocarbons such as benzene, cyclohexane, trimethylpentane and the n-alkanes; n-hexane through n-octane. Except for the supercritical water runs, these experiments were carried out at temperatures below the temperature where significant thermal decomposition of the coal occurs (i.e., ≦350°C). The objective of this work has been to establish the fundamental principles of coal-solvent interactions at or above the solvent critical point. Results from supercritical water extractions indicate that conversions ranged from 40% to 50% while extract yields ranged from 10% to 30% at 380°C. Extract yields between 0.7% and 6.2% were obtained with lower temperature extractions (≦350°C) of a North Dakota lignite using various simple hydrocarbon solvents at supercritical conditions. These yields were found to increase with increasing solvent temperature and solvent pressure or density. In contrast to the extractions with supercritical hydrocarbon solvents in which the extract was composed mainly of alkanes and long-chain fatty acids and the yield of extract varied little with temperature and pressure, the extraction with supercritical methanol showed a dramatic increase in extract yield with increasing temperature and pressure. The composition of the extract varied with the increase in temperature, with phenolics and methyl ethers predominating at the higher temperatures (up to 350°C). 40 refs., 28 figs., 20 tabs.

45595 (DOE/FE/60922—H1) Proceedings of the twelfth annual underground coal gasification symposium. (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Oil, Gas and Shale Technology). 1986. Contract AH01-86FE60922. 475p. (CONF-860822—). NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE86011811.

From 12. annual symposium on underground coal gasification; Saarbrucken, F.R. Germany (25 Aug 1986).

Papers presented a the 12th Underground Coal Gasification Symposium are included in this proceedings. These are grouped under: economic aspects; technology status I; technology status II; experimental laboratory work; modeling; general subjects - poster display; and environmental aspects. Selected papers have been processed for inclusion in the Energy Data Base. (AT)

45596 (DOE/MC/19207—2133) Plasticity, agglomeration and volatiles secondary reactions in coal pyrolysis. Final technical progress report. Howard, J.B.; Fong, W.S.; Serio, M.A.; Beitz, B.R.; Hsu, J.; Lennox, R.B.; Montero-Garcia, J.H.; Sawada, K.; Sontheimer, S.G.; Suzuki, Takeo. (Massachusetts Inst. of Tech., Cambridge (USA)). Jul 1986. Contract AC21-82MC19207. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86013321.

Initial softening of the coal is by physical melting of an estimated 25% by weight of the coal. Up to 40% by weight of the coal is further converted to liquids by pyrolytic bond breaking.

These liquids can condense or polymerize to give higher molecular weight liquids and solids, and crack to give gas and coke, or escape from the coal particle to give tar. The result is that the liquid weight averaged molecular weight can increase from 570 to above 800, and then decrease to around 600. Experimental viscosity and intraparticle liquid formation/depletion data are described by a global model that accounts for melting, generation and depletion of the liquid, and volatiles formation. The kinetic parameters find quantitative application in modeling coal particle agglomeration and swelling behavior under rapid heating conditions. Predictions of models here developed are in qualitative accord with literature data on swelling. The homogeneous secondary reactions of tar appear to be well-described by a model which includes three "lumps" of high, medium, and low reactivity. These lumps imply the existence in tar of three broad classes of bond strengths. Analysis of the data on tar and other products allowed identification of many of the bonds in each group. In general, the homogeneous secondary reactions involve cracking at the periphery of aromatic rings, which remain largely intact, leading to lower molecular weight tars and light products (gases, light oils). The conversion of aromatic rings results in a direct relationship between the fractions of aromatic carbon or aromatic hydrogen and the tar conversion, allowing the determination of kinetic parameters from analytical measurements on surviving tar. 40 refs., 54 figs., 4 tabs.

45597 **(DOE/MC/20183—2074) Low-energy process for separating coal gasification products. Final report.** Yang, R.T.; Cen, P.L.; Ritter, J.A. (State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering). Aug 1985. Contract AC21-83MC20183. 177p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86006633.

The program was aimed at demonstrating the feasibility and establishing the optimum conditions for separating coal gasification products by pressure swing adsorption (PSA) using activated carbon as the sorbent. A data base was developed for the equilibrium adsorption of H_2, CO, CH_4, CO_2, H_2S and their mixtures on carbon in the temperature range of 20 to 110°C and pressure range of 0 to 900 psig. The mixture data were fitted with four theories: ideal adsorbed solution, real adsorbed solution, loading ratio correlation, and linear partial pressure. Deviations between theory and experiment varied from 2 to 50%, which are in the same range as literature data for other gas-solid systems. Several PSA cycles were developed for separating coal gasification products. A typical 5-component mixture at 100 to 300 psig could be separated into three useful products: clean H_2 (<0.01% H_2S) at >99% purity, clean fuel gas, and an acid gas containing over 5% H_2S and 60% CO_2. Three models were developed for bulk PSA separations; equilibrium, linear driving force, and pore diffusion. The models were capable of predicting all observed PSA characteristics. Large temperature excursions were observed in bulk PSA processes. Improved PSA cycles to overcome the temperature excursions and hence to give better separations were suggested. 28 refs., 58 figs., 22 tabs.

45598 **(DOE/MC/21377—2155) ASPEN sensitivity study for the Great Plains Gasification Plant gasifier model, documentation and experimental verification.** Benjamin, B.W. (Scientific Design Co., Inc., New York (USA)). 23 Jul 1986. Contract AC21-84MC21377. 258p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86014073.

A previously developed ASPEN model of a coal gasifier, RGAS, has been used to simulate the operation of the Morgantown Energy Technology Center (METC) 42 inch gasifier under actual test conditions. The preliminary METC test data provided to Halcon for this study was for two coals, Arkwright coal and Indian Head lignite. Either air or oxygen was used as the oxygen source. RGAS was designed to calculate the variables which characterize gasifier performance. The kinetic expressions employed for this study were the Ash Segregation equations of the University of Delaware model. A full discussion and description of the differential equations used in the gasifier model (including the devolatilization model) was provided in a previous topical report (Rinard 1985). The structure of the ASPEN model and previous simulation results were described in another topical report (Benjamin 1985). For completeness, the model structure information contained in these topical reports has been carried over to this study. Thus, this report can be used as a stand-alone guide to RGAS. The model and software generated in the previous study were not changed in this effort. This investigation was directed towards applying the RGAS model to the simulation of actual plant operation by tuning the appropriate kinetic parameters. The period of METC operation which appeared to be the most stable and which had the best material balance closure for each type of coal was selected as the most suitable candidate for tuning. The kinetic constants of the selected kinetic model were adjusted to yield an outlet gas composition close to that reported by METC. The method of tuning is explained in the report.

45599 **(DOE/MC/21377—2156) ASPEN sensitivity study for the Great Plains Gasification Plant Methanation Section.** Benjamin, B.W.; Cascone, R.F. (Scientific Design Co., Inc., New York (USA)). 25 Jul 1986. Contract AC21-84MC21377. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86013961.

A previously developed ASPEN (Advanced System for Process Engineering) model of the Methanation Section (Section 1700) of the Great Plains Gasification Plant was enhanced. In this study, the original model was modified to conform with a set of preliminary computer process control diagrams from the plant. In addition, a detailed simulation of the utility requirements of the Methanation Section was included. Two types of flowsheet studies were conducted. Design cases were those simulations in which the equipment size was calculated based on such stated system requirements as a fixed temperature approach for a given heat exchanger. Rating cases were those simulations in which the size of the reactors and heat exchangers were fixed. The design case developed in this study was shown to be fairly robust in perturbation studies. However, the rating model developed from the design base case was not as flexible when subject to perturbations in hydrogen feedrate. This was to be expected since the amount of hydrogen entering the reactors has a great effect on the heat generated in the reactors. This heat must be removed in the heat exchangers, which, in the rating case, were of fixed size. The simulations clearly show that an increase in hydrogen in the feed to the methanation section can not be compensated for by the heat exchange network currently in use.

45600 **(DOE/MC/21377—2158) ASPEN sensitivity study for the Great Plains Gasification Plant rectisol section.** Farrell, R.J.; Rinard, I.H. (Scientific Design Co., Inc., New York (USA)). 25 Jul 1986. Contract AC21-84MC21377. 677p. NTIS, PC A99/MF A01; 1; GPO Dep. File Number DE86014075.

A previously developed ASPEN model of the Rectisol portion of the Great Plains Plant has been extensively revised to more closely represent the as-built plant as reflected by the plant control (PMX) diagrams. The revised models have been used to obtain a closed material balance of the Rectisol Plant. This corrects the main deficiency of the initial model which had never been run to a closed material balance. For simulation purposes, the plant is divided into three sections and a rigorous ASPEN model has been developed for each of the sections: (1) H_2S Absorption and Flash Regeneration, (2) Hot Regeneration and Naphtha Extraction, and (3) Methanol Recovery and Naphtha Stripping. A single Linear ASPEN Model for the entire Rectisol Plant has also been developed for the purpose of converging the models to a closed overall material balance. Extending ASPEN by incorporating a Simultaneous Modular convergence algorithm was investigated. This worked successfully for several simple problems including that of Cavett, although there were no computer running time advantages over the conventional Sequential Modular approach. When applied to more complex problems such as the Rectisol Plant, it failed for a variety of reasons and the rigorous section models combined with a separate linear model approach was used instead. 13 refs., 11 figs.

45601 **(DOE/METC—86/6038) Hot gas cleanup for electric power generating systems.** (USDOE Morgantown Energy Technology Center, WV). May 1986. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86006607.

The US Department of Energy (DOE), Morgantown Energy Technology Center (METC) is sponsoring research on advanced methods for removing contaminants from the hot, fuel gas streams of coal-fired combustion or gasification plants. Contami-

nants present in all coals such as ash particles, compounds of sulfur and nitrogen, and alkali metals must be controlled because they are environmental problems, are detrimental to advanced generation power equipment, or both. Significant advances have been made in the high-temperature control of these contaminants. One of the most promising advanced power-generating systems uses hot gas cleanup in an integrated, gasification combined-cycle (IGCC) concept to control coal contaminants. This report discusses the status and significant accomplishments of hot gas cleanup research in support of this advanced power generation system. The objective of the DOE hot gas cleanup program is to develop the technology to economically remove hot gas-stream contaminants. The projects that comprise the program are mainly aimed at gas streams generated at pressures greater than 6 atmospheres and temperatures greater than 1000°F. These elevated pressures and temperatures are typical of emerging technologies such as IGCC and gasifier/molten-carbonate fuel-cell (MCFC) power plants, direct-fired coal turbines, and pressurized fluidized-bed combustors. Control and removal of the contaminants is either a technical limitation or a major cost associated with these advanced systems. 113 refs., 18 figs., 4 tabs.

45602 **(DOE/PC/50798—T14) Catalyzed gasification of coal: isotope and XPS studies, May 16-August 15, 1986.** Falconer, J.L. (Colorado Univ., Boulder (USA)). 15 Aug 1986. Contract FG22-82PC50798. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014358.

This research aims to elucidate the reaction mechanism for the catalytic gasification of coal by metal carbonates, by identifying the reaction pathways and the active form of the catalyst. The insight into the mechanism will help in improving process kinetics of coal gasification. Alkali carbonates and alkaline earth carbonates are being used to catalyze the carbon dioxide-carbon gasification reaction. Temperature-programmed reaction, isotopic labeling of the carbon and oxygen atoms in the carbonate, and mass spectrometric detection of labeled products are used to identify reaction pathways. X-ray photoelectron spectroscopy (XPS) analysis of carbon-carbonate mixtures is used, at reaction conditions, to determine the chemical state of the carbonate.

45603 **(DOE/PC/70786—T6) Transition metal catalysis of hydrogen shuttling in coal liquefaction.** Eisch, J.J. (State Univ. of New York, Binghamton (USA)). 1 Apr 1986. Contract FG22-84PC70786. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013314.

The ultimate objective of this research is to uncover new catalytic processes for the liquefaction of coal and for upgrading coal-derived fuels by removing undesirable organosulfur, organonitrogen and organooxygen constituents. Basic to both the liquefaction of coal and the purification of coal liquids is the transfer of hydrogen from such sources as dihydrogen, metal hydrides or partially reduced aromatic hydrocarbons to the extensivearomatic rings in coal itself or to aromatic sulfides, amines and ethers. Accordingly, this study is exploring how much crucial hydrogen-transfer processes might be catalyzed by soluble, low-valent transition metal complexes under moderate conditions of temperature and pressure. During the sixth quarter the following studies were undertaken: comparative hydrogen shuttling studies were conducted with 1,4-dihydrobenzene, 1,4-dihydronaphthalene and 9,10-dihydrophenanthrene; carbon-carbon bond cleavage reactions were undertaking with 1,2-diarylethanes and strained hydrocarbons, such as 1,2,3-triphenylcyclopropene; and attempts continue to obtain suitabe crystals of certain intermendiates in nickel-promoted cleavage reactions. The following progress has been made: comparative hydrogen-shuttling studies of these aromatics show that $Ni(Cod)_n$ can catalyze hydrogen transfer approximately in this decreasing order: 1,4-dihydrobenzene > 1,4-dihydronaphthalene > 9,10-dihydrophenanthrene; 1,2,3-triphenylcyclopropene is readily cleaved by Ni(Byp)(Cod) to yield triphenylpropene isomers upon hydrolysis; and samples of $LiAlH_3(Byp)Ni$ are being prepared for x-ray crystal structure determination.

45604 **(DOE/PC/70791—T5) Studies in chemical and electrochemical coal conversion. Technical progress report, February 1-April 30, 1986.** Kubiak, C.P. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). 1986. Contract FG22-84PC70791. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014160.

The deoxygenation of phenols to arenes is a conceptually simple, yet synthetically difficult organic transformation. The deoxygenation of phenolic residue is also of extreme importance in coal liquefaction and in obtaining high quality organic feedstocks from coal derived liquids. Although a very small number of successful methods have been reported for phenol deoxygenation, these often require stringent reaction conditions which limit reaction scope and product selectivity. A highly attractive goal is to devise a transition metal mediated catalytic system which can effect the deoxygenation under mild conditions. Such a system could be of considerable practical importance for coal liquefaction. We describe a number of recent observations which directly address the problem of devising such a system. The deoxygenation of 2,6-dimethylphenol to m-xylene raises an exciting possibility of devising a catalytic system using the above $Pd_3(OAr)_6(dmpm)_3$ complexes. We are presently examining the effect of phenol concentration, temperature and pH in order to optimize the yields for arene production. In addition, efforts are in progress to establish the interrelationships of the different observed organometal species to understand the details of the reaction steps. The use of liquified coals as substrates for deoxygenation is planned. 5 refs.

45605 **(DOE/PC/70801—T7) Thermodynamic properties for supercritical coal conversion. Quarterly progress report, April 1-June 30, 1986.** Eckert, C.A. (Illinois Univ., Urbana (USA). Dept. of Chemical Engineering). 1986. Contract FG22-84PC70801. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013652.

The objective of this research is to investigate the behavior of supercritical fluid (SCF) systems for the purpose of processing coal. The medium temperature solubility apparatus completed last quarter is currently being run with supercritical ammonia solvent (Tc = 132°C). Solubilities of anthracene were measured at 142°C and 162°C over a pressure range of 1850 to 5000 psia. Runs with dodecahydrotriphenylene have been completed at 142°C. Runs at 162°C are currently in progress. We attempted to determine the solubility of thioxanthone in ammonia but the solute appears to be reacting and is under investigation. Phenazine and thianthrene were too soluble to obtain reasonable results with the apparatus. The solubility of dibenzothiophene and dibenzofuran in carbon dioxide have been measured at 35, 50, and 70°C in the low temperature apparatus. Studies with carbazole were discontinued due to virtual insolubility at these low temperatures. However, we have measured the solubility of thianthrene in carbon dioxide at 35 and 50°C. Runs at 70°C are currently in progress. High temperature supercritical solvents like ammonia show significant potential in extracting coal type compounds. Studies with anthracene and dodecahydrotriphenylene indicate higher solubilities than in lower temperature solvents like carbon dioxide. 3 figs.

45606 **(DOE/PC/71257—T7) Novel experimental studies for coal liquefaction. Quarterly progress report, April 1-June 30, 1986.** Holder, G.D.; Shah, Y.T.; Tierney, J.W. (Pittsburgh Univ., PA (USA)). 1986. Contract FG22-84PC71257. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013559.

Progress reports are presented for the following two tasks: (1) thermal behavior of slurry reactors used for indirect coal liquefaction; and (2) coal liquefaction under supercritical conditions. For task 1, work is being done using three indirect liquefaction routes involving synthesis gas - the Fischer-Tropch reaction, the one-step conversion to methanol, and the two-step conversion to methanol. Experimental work during the last quarter was concentrated on examining the first step of the two-step process - the carbonylation of alcohols using potassium alcoholates as the catalyst. The alcohol used was methanol; the catalyst used was potassium methoxide. The reaction was very selective to methyl formate. The only observable by-products were a small amount of white precipitate and formaldehyde. The objective of task 2 is to measure transfer rates for naphthalene extraction by carbon dioxide in order to determine how mass transfer coefficients vary with pressure, flow rate and bed height. During this past quarter, the new apparatus worked effectively and mass transfer coefficients were obtained at 20 atm and 25C. 8 figs., 3 tabs.

45607 **(DOE/PC/80023—T5) Development of an in-situ hydrogen measuring instrument for coal liquefaction processes. Quarterly report, April-June 1986.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1986. Contract AC22-85PC80023. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014251.

During this three-month-period, the work on the container boxes was finished, together with the computer-control-box and the new probe for Wilsonville. Pressure test on all these equipment was done and no leaks were found. Also the system was tested on our laboratory and was found to be working properly. Some changes were done in the equipment installed at the university in order to obtain more reliable data. Data of solubility of hydrogen in tetralin were taken, and the system hydrogen-ethane-tetralin was studied. The data of solubility are in good agreement with the literature.

45608 **(DOE/PC/80509—T3) Enhanced coal liquefaction by pyrolysis in supercritical fluids. Quarterly progress report, April-June 1986.** Paulaitis, M.E.; Klein, M.T.; Sandler, S.I. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1986. Contract FG22-85PC80509. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013959.

This research program involves a fundamental investigation of a novel coal liquefaction process that combines pyrolysis and supercritical-fluid solvent extraction. The experimental work consists of determining: (1) coal pyrolysis reaction pathways, kinetics and mechanisms; (2) equilibrium solubilities of coal-related compounds (e.g., primary liquefaction products) in supercritical water and solvent mixtures containing selected primary liquefaction products with supercritical water. Experiments involving model coal compounds will be accomplished to determine the fundamental factors associated with the mild pyrolysis of coal in supercritical fluids with the aim of developing optimal conversion strategies for actual coals. The thermolysis of phenethyl phenyl ether (PPE) and diphenyl propane (DPP) was studied in both neat solution and in water. The reaction network for PE in water exhibits an additional pathway in water. This pathway is the solvolysis of PPE to produce phenethyl alcohol and phenol. The product spectrum obtained for neat phyolysis of DPP was identical to that obtained for thermolysis in water. Thus the additional solvolysis pathway is not observed for this model coal compound reacting in water. 3 figs.

45609 **(DOE/PC/81201—T3) Microbial removal of organic sulfur from coal. Third quarterly report, April-June 1986.** Fannin, K.F.; McKinley, V.L.; Conrad, J.R.; Maka, A. (Institute of Gas Technology, Chicago, IL (USA)). Jun 1986. Contract AC22-85PC81201. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013888.

Initial screenings of enrichment cultures of coal storage area soils have identified cultures capable of degrading dibenzothiophene and benzothiophene aerobically or anaerobically. Work is now under way to identify the optimal conditions for degradation. 1 fig., 8 tabs.

45610 **(DOE/RA—50137-1) Feasibility study for the production of low/medium-Btu gas from coal for Tri-City Regional Port District.** (Dravo Corp., Pittsburgh, PA (USA)). Feb 1981. 313p. NTIS $24.00.

To determine the technoeconomic feasibility of a coal-gasification plant supplying energy to an industrial park in Illinois, Dravo examined three cases: (1) a minimum-requirement, 1.36 trillion Btu/yr, three-gasifier, low-Btu plant, (2) four variations of a 10.5 trillion Btu/yr medium-Btu plant using 21-30 gasifiers (all four schemes could be added on to the Case 1 plant), and (3) an ultimate-capacity, 10.1 trillion Btu/yr, 15-gasifier, medium-Btu facility, along with an 1100 ton/day oxygen plant. All gasifiers considered were Wellman-Galusha. Dravo recommended that the Tri-City Regional Port District, which operates the park, build the smallest coal-gas plant and allow for using low-grade landfill gas as a supplement when it becomes available. The Case 1 gas cost of $5.82/million Btu, though higher than that of the Case 2 and 3 schemes ($5.05-5.70/million Btu), is substantially lower than fuel oil prices.

45611 **(ORNL/FETEP—14) Toxicological benchmarks for synfuels characterization.** Griest, W.H.; Tomkins, B.A.; Smith, L.H.; Buchanan, M.V.; Higgins, C.E.; Epler, J.L.; Witschi, H.R. (Oak Ridge National Lab., TN (USA)). Aug 1986. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014411.

High-boiling petroleum distillates are quite different from crude coal liquids of similar boiling range and more likel hydrotreated coal liquids in their content of PAH dermal tumorigens, tumorigenicity, and mutagenicity. Refining levels our differences in the composition among the crude oils, and lesser compositional differences are observed for their refined naphthas. Differences (if any) in the toxicity of the vapors of the naphthas are likely to be small and subtle. More complex and comprehensive biological testing would be required to quantitate differences in potential health effects. However, the results suggest that the HFO/HD and VGO distillates of these petroleum crude oils are not substantially more mutagenic or tumorigenic than the undistilled petroleum crude oils, in comparison to crude coal liquids. Thus, there do not appear to be any substantial advantages to preparing and using distillate fractions (at least of these) petroleum crude oils as benchmarks for comparative mutagenicity and tumorigenicity testing. The original data in the literature on unfractionated petroleum crude oils appear suitable for comparison with coal liquids. The concentrations of selected four- to six-ring PAH dermal tumorigens in the high boiling distillate fractions of lighter petroleum crude oils were found to be only ca. 2.5 times more concentrated than in the undistilled crude oils. Further, these PAH in the distillate fractions were at least one to two orders of magnitude lower than in crude coal liquids of comparable boiling range, and more similar to those of hydrotreated coal liquids. 26 refs., 2 figs., 12 tabs.

45612 **(ORNL/FMP—86/5) Consolidated bibliography of publications of the advanced research and technology development (AR and TD) Fossil Energy Materials Program, October 1, 1979-April 30, 1986.** Carlson, P.T. (comp.). (Oak Ridge National Lab., TN (USA)). Aug 1986. Contract AC05-84OR21400. 105p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86014336.

The objective of the Advanced Research and Technology Development (AR and TD) Fossil Energy Materials Program is to conduct long-range research and development that addresses the materials needs of fossil energy systems, including materials for coal preparation, coal liquefaction, coal gasification, heat engines and heat recovery, coal combustion systems, fuel cells, magnetohydrodynamics, and oil shale processing. Materials research that addresses materials problems generic to several fossil energy technologies is emphasized. This consolidated bibliography of publications of the AR and TD Fossil Energy Materials Program covers those publications issued under the auspices of the Program from October 1, 1979 through April 30, 1986. The publications contained in this document have been limited to (1) topical reports, (2) open literature publications in refereed journals, (3) full-length papers in published proceedings of conferences, (4) full-length papers in unrefereed journals, and (5) books and book articles. Each of the above types of publication is divided in Part II into three principal materials categories: (1) metals and alloys, (2) structural ceramics, and (3) refractories. Furthermore, each of the materials areas is subdivided into technology or discipline categories which represent principal areas of materials research and experience in fossil energy systems. Part III contains a listing of the bibliography according to performing organization.

45613 **(ORNL/TM—10066) Evaluation of selected elastomer O-ring pump seals for service at the Wilsonville, Alabama, Advanced Coal Liquefaction Research and Development Facility.** Skena, C.C.; Keiser, J.R. (Oak Ridge National Lab., TN (USA)). Aug 1986. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014414.

Previous laboratory tests of elastomer O-rings in coal liquefaction solvents conducted at L'Garde, Inc., indicated that certain ethylenepropylenediene monomer (EPDM) compounds provided the best performance when a backup ring was used to limit swelling. Before service testing in a pump at the Wilsonville, Alabama,

Advanced Coal Liquefaction Research and Development Facility, tests of six selected elastomers in the appropriate Wilsonville-produced solvent were conducted at Oak Ridge National Laboratory (ORNL). The ORNL tests measured the elastomers' changes in cross section, weight, density, and relative flexibility. Although two perfluoroelastomers showed less degradation of most properties during these tests, it was decided to proceed with service testing of two EPDM elastomers because of their much lower cost. 5 refs., 14 figs., 7 tabs.

45614 **(PB—86-203296/XAB) Process description of the WyCoalGas gasification project. Topical report.** Skinner, F.D.; Meserole, N.P. (Radian Corp., Austin, TX (USA)). Jan 1986. 135p. NTIS, PC A07/MF A01.

The WyCoalGas project involved the design, construction, and operation of a surface mine and coal-gasification plant (based on the use of Lurgi and Texaco gasification) to produce 300 million scfd of substitute natural gas from Wyoming subbituminous coal. The original plant design was later reduced to half this size, with some plant systems having the full-scale capacity due to sparing. The project was eventually terminated. However, much of the design and permitting work had been done, and these results, although incomplete, were published. The document gives the available informaticn and data on the WyCoalGas plant with emphasis on environmental and health aspects. The presentation, which is the third in a series of documents, is arranged for ease of comparison of the plant configurations of and EH&S data from other coal-gasification plants included in the study.

45615 **(PNL—5375) Separation of gas mixtures by supported complexes.** Nelson, D.A.; Lilga, M.A.; Hallen, R.T.; Lyke, S.E. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014946.

The goal of this program is to determine the feasibility of solvent-dissolved coordination complexes for the separation of gas mixtures under bench-scale conditions. In particular, mixtures such as low-Btu gas are examined for CO and H_2 separation. Two complexes, $Pd_2(dpm)_2Br_2$ and $Ru(CO)_2(PPh_3)_3$, were examined in a bench-scale apparatus for the separation of binary ($CO-N_2$ or H_2-N_2) and quinary (H_2, CO, CO_2, CH_4, and N_2) mixtures. The separation of $CO-N_2$ was enhanced by the presence of the palladium complex in the 1,1,2-trichloroethane (TCE) solvent, especially at high gas and low liquid rates. The five-component gas mixture separation with the palladium complex in TCE provided quite unexpected results based on physical solubility and chemical coordination. The complex retained CO, while the solvent retained CO_2, CH_4, and N_2 to varying degrees. This allowed the hydrogen content to be enhanced due to its low solubility in TCE and inertness to the complex. Thus, a one-step, hydrogen separation can be achieved from gas mixtures with compositions similar to that of oxygen-blown coal gas. A preliminary economic evaluation of hydrogen separation was made for a system based on the palladium complex. The palladium system has a separation cost of 50 to 60 cents/MSCF with an assumed capital investment of $1.60/MSCF of annual capacity charged at 30% per year. This assumes a 3 to 4 year life for the complex. Starting with a 90% hydrogen feed, PSA separation costs are in the range of 30 to 50 cents/MSCF. The ruthenium complex was not as successful for hydrogen or carbon monoxide separation due to unfavorable kinetics. The palladium complex was found to strip hydrogen gas from H_2S. The complex could be regenerated with mild oxidants which removed the sulfur as SO_2. 24 refs., 26 figs., 10 tabs.

45616 **An overview of DOE/METC coal projects and their application to petrochemicals production.** Wilson, J.S.; Halow, J.S.; Ghate, M.R. New York, NY; American Institute of Chemical Engineers (1986). 24p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

The coal resource of the United States is the largest domestic source of energy available to meet future energy needs. Exploitation of this resource in an economical and environmentally acceptable manner, however, will require development of a variety of coal conversion and utilization technologies. Coal gasification is a versatile process and is a key component in many of the promising new coal utilization technologies. For electric power generation, the integrated gasification combined-cycle (IGCC) and gasification systems integrated with advanced cycles have the potential to offer high efficiency, low capital cost, and environmentally superior power generation technologies. The versatility of coal gasification extends beyond power generation. The success of the Tennessee Eastman Corporation in producing acetic anhydride from coal shows the potential of gasification as a route to chemical feedstock. There is also a potential for producing new fuels for transportation, industrial and residential heating, and for producing low-cost hydrogen. Limitations on achieving these goals today are the economics of these systems. Better understanding of coal gasification and gas cleanup, separation and upgrading techniques will undoubtedly improve the economics of these systems.

0105 By-products

REFER ALSO TO CITATION(S) 45616, 45687

0106 Properties

REFER ALSO TO CITATION(S) 45592, 45604, 45633, 45675

45617 **(DOE/FE/60181—2093) Organic structure. Final report for the period ending March 31, 1986.** Olson, E.S.; Diehl, J.W. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014276.

Molecular weight determinations have been performed (using low-angle laser light scattering photometry) on derivatives of a series of humic acid macromlecules derived from lignite. The humate derivatives oabtained from Beulah lignite by base extraction have molecular weights ranging from 1.3×10^6 to 4.3×10^6 daltons, from low and high yield extractions respectively. Mild oxidation with p-nitroperbenzoic acid gave humic acids with slightly larger molecular weights, again inversely proportional to the yields. The nature of the aliphatic bridging groups in low-rank coals has been investigated by ruthenium tetroxide oxidations using isotope dilution GC/MS methods for analysis of the product carboxylic acids derived from oxidation of the aromatic portions of the coal. The oxygen content of coals was studied using a new spectroscopic technique, high resolution x-ray fluorescence spectroscopy. This methods was investigated for direct quantitative oxygen analysis as well as for characterization of the type of oxygen bonds in coal. The content of several of the original plant substructures, such as cellulose, lignin, and waxy materials, was investigated. 21 refs., 1 fig., 10 tabs.

45618 **(DOE/FE/60181—2094) Distribution of inorganics. Final report for the period ending March 31, 1986.** Hurley, J.P.; Steadman, E.N.; Kleesattel, D.R. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014277.

The objectives of the Distribution of Inorganics project were basically threefold. One objective was to develop methods for quantifying the inorganic associations within a coal sample. A second objective was to determine the distribution and variability of the inorganic matter within coal seams. The third objective was to develop a means to describe and quantify the macroscopic and microscopic organic (petrographic) components within a low-rank coal seam so that subsequent work could build on the methods developed in relating associations of inorganics and their variability to the petrographic components of coal. Two principal methods were developed to quantify the inorganic elements in coals according to association. One method, termed chemical fractionation, uses extractions with mild reagents to quantify the inorganic elements according to several modes of occurrence, i.e., ion exchangeable, organically complexed, acid soluble minerals, and acid insoluble minerals. A second method of quantifying coal inorganic matter (according to mineral phase) uses a Scanning Electron Microscope (SEM) point-counting method to quantify the individual minerals in the coal. The variations in the elemental content within coal seams

were determined by analyzing samples taken along stratigraphic sequences within coal seams by neutron activation analysis. The elements were classified according to their concentrations in the margins of the seams, center of the seams, or having no discernible pattern in their variations. Finally, a method was developed for classifying the petrographic components of low-rank coals according to component morphology, reflectance, and fluorescence. 100 refs., 9 figs., 12 tabs.

45619 **(DOE/FE/60181—2096) Physical properties and moisture. Final report for the period ending March 31, 1986.** Schobert, H.H.; Neumann, R.M.; Tye, C.; Bale, H.D.; Hauserman, W.B. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014279.

There are three major goals of this research project. The first is to develop methodologies and data on mechanical properties of crushed and finely ground low-rank coals and their mineral residues, relevant to their behavior and handling problems in gasification, liquefaction, and slurry transport applications. These properties include: shear strength, compressibility and permeability of dry, free-sliding coal; abrasiveness of finely ground coal and mineral residues in slurries; viscosity of coal and residue slurries in water and in coal-derived liquid products; porosity, defined as size distribution and continuity of pores and their variation through processing steps; mechanical and thermal friability; and shear and compressive strength of cokes or chars formed by devolatilization of coals. The second research goal is to relate observed mechanical or physical properties, such as elasticity, plasticity, or internal friction, to the three-dimensional structural arrangement of the coal macromolecules via the theories and models of polymer science. The third research goal is to determine the distribution and modes of incorporation of water in low-rank coals, and develop approaches for the measurement of "moisture" which can be interpreted in ways meaningful for low-rank coal utilization. 64 figs., 4 tabs.

45620 **(DOE/PC/70782—7) Electron spin mapping of coal molecular structure by ENDOR. Quarterly technical progress report.** Belford, R.L. (Illinois Univ., Urbana (USA)). 15 Apr 1986. Contract FG22-84PC70782. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014025.

Since the frequencies of modulation of the electron spin echo decay envelope correspond to those of ENDOR transitions, time domain spin echo data can be converted into an ENDOR-like spectrum with appropriate mathematical treatment. Typically this treatment has been Fast Fourier Transformation (FFT). However, because of several unique aspects of electron spin echo spectroscopy this method may be inadequate. We have investigated some of the other methods available as well as ways of adapting FFT for use with spin echo data and in this report we summarize some of our recent work in these areas. 5 refs., 3 figs.

45621 **(DOE/PC/70791—T4) Studies in chemical and electrochemical coal conversion. Technical progress report, August 1, 1985-January 31, 1986.** Kubiak, C.P. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). 1986. Contract FG22-84PC70791. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013276.

Carbon dioxide is the world's most abundant potential single source of carbon. The chemistry of CO_2 is also of fundamental importance to a broad range of coal conversion technologies. The activation and reduction of carbon dioxide are also areas of intense fundamental research interest. The preparation, structure, and N-alkylation chemistry of the "cradle" type complex $Ni_3(\mu\text{-}CNMe)(CNMe)_3(dppM)_3$, [1], (dppM) = bis(diphenylphosphino methane) were recently described by us. We now report the role the nucleophilicity of the μ-methyl isocyanide ligand of complex [1] plays in activating the CO_2 molecule. We also report the $2e^-$ redox chemistry of [1]. Together, the chemical and electrochemical characteristics of [1] provide an interesting opportunity for electrochemically induced CO_2 activation.

45622 **(DOE/PC/80533—T3) Structural characterization/correlation of calorimetric properties of coal fluids. Third quarterly report, March 1-May 31, 1986.** Starling, K.E.; Mallinson, R.G.; Lee, L.L.; Li, M.H.; Peters, M.W.; Hulvey, R.D. (Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science). 1986. Contract FG22-85PC80533. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013588.

The proposed correlation frameworks for calorimetric properties of coal fluids have been tested for model binary mixtures. For calculating the calorimetric property for real fluids, one needs to calculate (1) departure function from equation of state and (2) ideal gas calorimetric property. The binary systems of n-pentane-tetralin, n-pentane-t-decalin and n-octane-benzene were selected for test. The enthalpy calculations were performed based on the following two cases: Case I. the literature ideal gas enthalpies were used in the calculation. This is mainly to test the equation of state capability of estimating the enthalpy departure function. Case II. the ideal gas enthalpies were calculated by Benson group contribution method. 3 refs., 2 figs., 2 tabs.

45623 **(EUR—10366-EN) Certification of the contents (mass fraction) of carbon, hydrogen, nitrogen, chlorine, arsenic, cadmium, manganese, mercury, lead, selenium, vanadium and zinc in three coals. Gas coal CRM No. 180; Coking coal CRM No. 181; Steam coal CRM No. 182.** Griepink, B.; Colinet, E.; Wilkinson, H.C. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 172p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information.

The report first describes the preparation of three coal reference materials: Gas coal (BCR No. 180), Coking coal (BCR No. 181) and Steam coal (BCR No. 182). It deals further with the homogeneity and stability tests for major, minor and trace components. The contents (mass fractions) of the elements: C, H, N, Cl, As, Cd, Mn, Hg, Pb, Se, V and Zn are certified. The analytical techniques used in the certification are summarised. All the individual results are given and recommendations for analysis are made.

45624 **Relationship between chemistry and rheology in coal-water slurries.** Chapman, R.N.; Lynch, A.W. New York, NY; American Institute of Chemical Engineers (1986). 13p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

Rheology is a critical performance specification for coal-water slurries. The primary role of additives is to modify rheology and to optimize performance. The effect of an additive is dependent on the chemical interactions between the additive, the surface of the coal, and the slurry liquor. Using a novel Helical Screw Rheometer developed at Sandia, which functions as a small-scale flow loop, the authors measure rheology in situ and withdraw slurry samples as functions of time. They use fresh coals that have been stored under inert atmosphere after being mined. Since unweathered coals are fairly reactive, the coal surface and slurry liquor change with time. Through extensive analyses of the coal surface and slurry liquor, they determine that chemical changes have taken place, and for two coals (bituminous and sub-bituminous) and several additives (nonionic and anionic), they determined the nature of these chemical changes and how they affect rheology.

45625 **Comparison of a nonionic surfactant and an anionic dispersant as coal water additives.** Casassa, E.Z.; Toor, E.W.; Atlas, H. New York, NY; American Institute of Chemical Engineers (1986). 13p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

Coal slurry behavior depends upon particle surface charge and degree of wetting. The effects on slurry properties of a nonionic surfactant which decreases slurry liquid surface tension, and of an anionic dispersant which decreases particle hydrophobicity, are examined in relation to coal ash content and oxidation history. Observation of electrophoretic mobility and other properties of concentrated coal suspensions, with and without additives, im-

proves understanding of the mechanisms by which additives affect slurry properties.

45626 **Analytical applications of ultrasensitive polarization measurements.** Bobbitt, D.R. Ames, IA; Iowa State Univ. (1985). 202p. University Microfilms Order No. 86-04,449.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Recent advances in the measurement and utilization of the polarization properties of light are presented. Since optical activity is usually an indication of biological activity, past or present, optical rotation detection (ORD) can impart a unique selectivity to the chromatographic analysis of complicated geochemical samples. The advantages of selective detection will be demonstrated for several coal liquids, and LC-ORD will be shown to be useful for the fingerprinting of coals as well as for following the degree of processing of a fossil fuel. Microcolumn technology using a micropolarimeter was used for this work. When an optically active solvent is used with the micropolarimeter, optically inactive analytes can be detected as they elute from a microcolumn. This technique, termed indirect polarimetry, has converted the very selective micropolarimeter into a sensitive universal detection scheme superior to the conventional refractive index detector. Additionally, it will be shown that indirect polarimetry can be used to detect analyte absorptions with excellent sensitivity. The theoretical and experimental considerations necessary to obtain simultaneous selective, universal and absorption information will be discussed. Raman spectra can be obtained by monitoring the polarization properties of a probe field while it interacts with a Raman shifted pump field. An analytical investigation of this technique, the Raman induced Kerr effect will be presented, along with a unique optical null capable of suppressing spectral and nonresonant background interferences.

45627 **Structural variations in coal macerals: application of two-dimensional and dipolar dephasing ^{13}C-NMR techniques.** Pugmire, R.J.; Woolfenden, W.R.; Mayne, C.L.; Karas, J.; Grant, D.M. (Univ. of Utah, Salt Lake City). *ACS Symposium Series;* 79-97(1984). Contract FG22-80PC30226.

Cross-polarization magic-angle spinning, dipolar dephasing, and two-dimensional dipolar dephasing carbon-13 NMR techniques were used to study structural variations in coals and coal macerals. The macerals were separated by density-gradient centrifugation. Data on 36 coal and maceral samples are given. Aromatic carbons, bridgehead carbons, and aliphatic carbons were distinguished.

45628 **Preliminary studies on the aromaticity of Australian coals.** Russell, N.J.; Wilson, M.A.; Pugmire, R.J.; Grant, D.M. (CSIRO Div. of Fossil Fuels, North Ryde, Australia). *Fuel;* 62: 601-605(May 1983). Contract FG22-80PC30226.

The aromaticities of samples from nine Australian coal seams, including pairs of hand-picked vitrains and durains, were determined by carbon-13 CP/MAS NMR spectroscopy. The results clearly show that the aromaticity of the coals increases with increase in vitrinite reflectance and carbon content and decrease in atomic H/C ratio. For a given coal seam, durain (inertinite-rich coal) has a higher aromatic value than vitrain (vitrinite-rich coal). The trends for carbon content and atomic H/C are in good agreement with results from North American coals; however, the aromaticities of Australian coals obtained in this study appear to be slightly lower than some of those reported for North American coals of similar carbon content.

0108 Waste Management

REFER ALSO TO CITATION(S) 45601, 45643

45629 **(EPRI-CS—4699-Vol.1) FGD maintenance guidelines. Volume 1. FGD maintenance programs. Final report.** Davidson, L.N.; Miller, G.P.; Wedig, C.P.; Slack, A.V. (Stone and Webster Engineering Corp., Boston, MA (USA); SAS Corp., Sheffield, AL (USA)). Jul 1986. 313p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920417.

The "FGD Maintenance Guidelines" was written to fill a need for maintenance information that applies specifically to flue gas desulfurization (FGD) systems. Previously there was no single source of data describing FGD maintenance. Usually maintenance managers relied on suppliers' operating and maintenance manuals, past FGD experience, or procedures from other areas of a power plant. There are two volumes in the "Guidelines," intended to assist utility personnel in planning and performing maintenance for FGD systems. Different aspects of maintenance are emphasized in each volume. Volume 1, FGD Maintenance Programs, provides guidance for supervisory personnel involved in planning maintenance. It describes the utility industry's experience with FGD maintenance programs, a procedure for organizing and managing maintenance programs, and ways to design FGD systems for maintainability. The section about implementing a maintenance program contains a detailed example illustrating the procedure, based on experience of an actual operating FGD system. 12 refs., 19 figs.

45630 **(PB—86-215613/XAB) Literature searches on metal recovery by leaching and carbothermic reduction.** Hassett, D.J.; Mitchell, M.J. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Apr 1985. 205p. NTIS, PC A10/MF A01.

Literature searches were done on methods for metal recovery by leaching and carbothermic reduction. The focus of these searches was the recovery of metals (primarily aluminum) from low-rank coal combustion and gasification ash. The final compilation included bibliographies, in-house generated computer searches, and manual searches.

0120 Mining

45631 **Dragline operator training simulator.** Contor, M. (Southern Illinois Univ. at Carbondale, Carbondale, IL). pp 20 of Third annual program of coal review abstracts. Carbondale, IL; Southern Illinois University Press (1982). (CONF-8204205—).

From 3. annual program of coal review; Carbondale, IL, USA (21 Apr 1982).

The presentation describes and documents the dragline operation simulation training program conducted at the Department of Energy facilities at Carterville, Illinois during the summer of 1981. The evaluation and verification of the dragline simulation program consisted of using two groups of mining personnel, as trainees, to evaluate three hands-on training devices, audio visual material and self paced student workbooks. Each training session was two weeks in duration and the student's progress was determined by written and performance evaluation techniques. A detailed description of the simulator, trainers, and classroom material is provided. The results, conclusions, and recommendations of the verification program are outlined and discussed. The current and future status of the dragline simulator program for operator training, mine supervisory training and academic course work for mining students are covered.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 45612, 45625, 46386

45632 **(DOE/FE/60181—2091) Fine coal cleaning. Final report for the period ending March 31, 1986.** Brown, D.J. (North Dakota Univ., Grand Forks (USA). Energy Research Center). Jun 1986. Contract FC21-83FE60181. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014274.

Washability data on coals from the western United States is generally very limited and their response to standard washing techniques cannot be predicted. To expand the data base, the Department of Energy initiated a washability study for both conventional and fine-size ranges of western coals. The Pittsburgh Energy Technology Center (PETC) performed float-sink washability testing on 156 western coals crushed to 1 1/2" x 0, 3/8" x 0, and 14 mesh x 0. The University of North Dakota Energy Research Center (UNDERC) performed centrifugal float-sink washability testing on

61 of those 156 test coals crushed to 65 mesh x 0. In addition, 35 of the 65 mesh x 0 coals were further reduced to 200 mesh x 0 and tested, and three coals were pulverized to 325 mesh x 0 and tested. Generally, the higher-ranked coals were most amenable to the gravity separation technique. Pulverized of study coals to finer grain size distributions did not significantly improve the coal's Washabilities, as float ash content of 200 mesh x 0 and 325 mesh x 0 samples were generally similar to 65 mesh x 0 float ash content. UNDERC also investigated the applicability of oil agglomeration and froth floatation on the benefication of four selected economically important western coals. In general, these tests were not as successful at beneficiating western coals as the standard float-sink technique, which provided the highest degree of ash separation at the highest weight yields. This final report summarizes work completed on the float-sink washability data base, oil agglomeration testing, and froth flotation testing at UNDERC from May 1983 through March 1986. 12 refs., 1 fig., 1 tab.

45633 **(DOE/PC/70003—T10) Coal pretreatment for two stage liquefaction. Quarterly report, April 1-June 30, 1986.** Derbyshire, F.J.; Luckie, P.T. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). 1986. Contract FG22-84PC70003. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014031.

Efforts have been continued to examine the utility of liquid-liquid separation for the pretreatment of subbituminous coals. Reasonable separations have been obtained in terms of yield, the enrichment of reactive macerals and the rejection of mineral matter when using a coal-derived distillate as the nonaqueous medium. An investigation of the influence of reaction conditions on temperature-staged catalytic liquefaction has been continued using tubing bomb reactors. With fixed second stage conditions (425°C, 10 min), a survey has indicated that, for a subbituminous coal, first stage reaction at 275°C and 30 min gives good overall conversion and a high-oil to asphaltene ratio. Using these conditions for the first stage, a survey has now been started to examine the influence of the second stage conditions on the net product distribution. Preliminary results show that higher oil yields are obtained at 450 than at 425°C without incurring excessive production of light hydrocarbon gases. Some studies have been made to examine the effect of catalyst concentration on temperature-staged liquefaction. Reducing the Mo concentration from 1.0 to 0.1% wt lowered the overall conversion by 7% and the oil yield by about 4%. The influence of solvent composition upon temperature-staged liquefaction has been studied using six distillate solvents supplied by Conoco Coal Research. Reactions were conducted in the 300 cc stirred autoclave using both subbituminous and bituminous coals. Preliminary data are presented and discussed. 5 refs., 2 figs., 8 tabs.

45634 **(IS-M—574) Coal deashing and desulfurization utilizing microwave irradiation at 2450 MHz.** Bluhm, D.D.; Markuszewski, R.; Richardson, C.K.; Fanslow, G.E.; Durham, K.S.; Green, T. (Ames Lab., IA (USA)). 1986. Contract W-7405-ENG-82. 11p. (CONF-860984—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86011398.

From British national committee for electroheat, heating, and processing conference; Cambridge, UK (23 Sep 1986).

An Experimental Microwave Applicator System has been constructed and tested for the cleaning of 50-g samples of coal using caustic treatment and microwave irradiation. At the present time, best results were obtained in the removal of ash by mixing one part of the coal with 2 parts of dry caustic, adding 10% water, and irradiating at 1.0 to 1.5 kW for 1 to 2 minutes. For the removal of significant amounts of sulfur, multiple treatment and further refinements in the procedure are required. 6 refs., 5 figs.

45635 **(PB—86-204385/XAB) Rheological analysis of a flyash slurry.** Grove, T.W. (British Hydromechanics Research Association, Cranfield). 1983. 16p. (RR—1997). NTIS, PC A03/MF A01.

The report covers work carried out on behalf of the National Coal Board. Rotational viscometry tests were undertaken to ascertain the characteristics of a flyash slurry and predict full-scale pipeline losses.

45636 **(PB—86-204856/XAB) Areas of application for research into three-phase flow.** Silvester, R.S. (British Hydromechanics Research Association, Cranfield). 1983. 56p. (TN—2089). NTIS, PC A04/MF A01.

The engineering applications for a knowledge of the flow of solid-liquid-gas mixtures have been reviewed. These have been broadly categorized as transport or process, the former including air-lifted solids and the latter fluidized reactors. Most existing work on transport applications has been centered around the mining of manganese nodules from the sea floor, though other applications have included air-lifting coal from deep land-based shafts. A novel means of using injected air to reduce the friction of non-Newtonian suspension flow is described; it had not been tested in an industrial context.

45637 **(PB—86-208857/XAB) Wear and performance of materials in pipelines for the hydraulic conveyance of fused ash.** Wright, G.J.; Garrett, G.G. (Council for Mineral Technology, Randburg (South Africa)). 3 Feb 1986. 19p. (MINTEK-M—242). NTIS, PC A03/MF A01.

The report describes a field investigation on the performance characteristics and wear processes of a range of wear-resistant materials that were inserted into a pipeline conveying fused ash. The performance characteristics and final cost-effectiveness of the materials are evaluated in terms of the particular characteristics of the conveying operation.

45638 **Use of coal liquid derivatives for preparation and stabilization of coal-water slurries.** Resavan, S.K.; Schruben, D.L. New York, NY; American Institute of Chemical Engineers (1986). 17p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

As the supply of fuel oil becomes insecure, it is anticipated that coal will capture a significant fraction of future energy growth. However, complete conversion of oil-fired facilities to coal would involve substantial capital expenditure. Coal-water slurry fuels can be used as a replacement for fuel oil in industrial facilities with only modest retrofits of existing equipment. These hybrid fuels offer a potential material cost advantage per Btu over neat fuel oil.

0140 Combustion

REFER ALSO TO CITATION(S) 45612

45639 **(CONF-860535—2) Mechanism of deposition in coal-fired gas turbine systems, October 1, 1985-October 1, 1986.** (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014595.

From 3. annual heat engines contractors' meeting; Morgantown, WV, USA (6 May 1986).

The objective of this task is to develop mathematical models which describe ash particle and vapor formation and transport in coal-fired gas turbines. These will characterize the important surface deposition phenomena on turbine blades and assess the effects of coal pretreatment and the range of operating conditions on turbine performance. This report presented some fine tuning of the deposition processes in a coal-fired gas turbine. The boundary layer nucleation theory gives the correct trends. The probabilistic sticking coefficient model agrees quite well with the experimental data. The gas phase simulations glean insight into the mechanism of SO_3 and Na_2SO_4 production. Much work remains in these last two: particle adhesion model refinement, and heterogeneous formation of Na_2SO_4. The first of these two depends strongly on the availability of data. It would be highly desirable to assist implementation of new experiments that would vindicate the model. The second of these entails the complications of adsorption onto particles or blades, surface diffusion, surface reaction, and possibly desorption. Laboratory-scale experiments are required to quantify both of these steps. 11 refs., 7 figs., 2 tabs.

45640 **(CONF-860940—1) Measurement of alkali vapor in PFBC flue gas and its control by a fixed granular bed of activated bauxite.** Lee, S.H.D.; Myles, K.M. (Argonne National Lab., IL (USA)). 1985. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86005551.

From Gas cleaning at high temperatures conference; Guildford, Surrey, UK (16 Sep 1986).

A fixed granular-bed sorber, with regenerable activated bauxite as the sorbent, for the control of the alkali vapor in the flue gas produced during pressurized fluidized-bed combustion (PFBC) of coal is being developed. In a gas stream closely simulating the actual PFBC flue gas, activated bauxite is shown to capture NaCl vapor by (1) chemical fixation of the vapor with the intrinsic clay minerals, probably to form thermally stable, water-insoluble sodium aluminosilicates and (2) chemical conversion of NaCl vapor into a condensed-phase sodium sulfate, which has a much lower vapor pressure than does NaCl. The latter predominates the capture process, and the captured sodium sulfate can be easily removed by simple water-leaching to restore the porosity of activated bauxite for reuse. A high-temperature ($\leqq$ 900°C) and high-pressure ($\leqq$ 10 atm) laboratory-scale, fixed, granular-bed alkali sorber has been operated with the Argonne National Laboratory PFBC combustor to (1) measure the alkali vapor concentration in the PFBC flue gas on a real-time, on-line basis, and (2) demonstrate the alkali sorber for the control of alkali vapor from an actual PFBC flue gas. The alkali (Na + K) vapor concentration in particulate filtered hot flue gas was measured to be <10 ppbW with the Ames analyzer. The same measurement with the APST was higher between 90 to 170 ppbW. Therefore, the possibility of sink for sodium vapor in the PFBC/alkali sorber system must be considered. 32 refs.

45641 **(DOE/ET/13011—T1) Operation and maintenance of DOE/PETC Combustion Test facilities. Final activity report, April 1978-December 19, 1982.** (Management and Technical Services Co., Library, PA (USA)). 1982. Contract AC22-78ET13011. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86013983.

In April 1978, Management and Technical Services Company/General Electric (MATSCO/GE) was awarded the contract to operate, modify and maintain the 700 HP Combustion Test Facility at the Pittsburgh Energy Technology Center. Through the life of this contract, the goal of 700 HP Boiler test programs was to establish the feasibility of coal slurries as an alternative to fuel oil in industrial and utility boilers. This same goal was established for 100 HP Boiler testing, which came under this contract in early 1980. Beginning with the Coal-Oil Mixture (COM) program in the 700 HP Boiler, a string of successful coal slurry test programs was achieved. The coal-water mixture (CWM) program was initiated in the 100 HP Boiler in 1980 and successfully moved to the 700 HP Boiler in 1981. The 100 HP Boiler's other coal slurry project was the coal-methanol test program. The other major projects in these two test facilities were the Solvent Refined Coal (SRC) test phases I and II. Fuel transport characteristic studies in support of these main projects were established in the contract in 1981. These studies included the Coal Water Flow Test Loop to study the transport characteristics of slurries and the two Coal Flow Test Loops to study solid coal transport phenomena. These programs are all detailed in this report, along with other projects which MATSCO/GE became involved in.

45642 **(DOE/MC/21171—2069) System design study to reduce capital and operating cost of a moving distributor, AFB advanced concept - comparison with an oil-fired boiler. Final report.** Mah, C.S.; West, L.K.; Anderson, R.E.; Berkheimer, I.L.; Cahill, D.V. (Aerojet Energy Conversion Co., Sacramento, CA (USA)). Dec 1985. Contract AC21-84MC21171. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86006627.

The Aerojet Energy Conversion Company, under contract with the United States Department of Energy, has performed a comparative economic study of the Aerojet Universal Atmospheric Fluidized Bed Combustion (UAFBC) system and a coventional atmospheric fluidized bed combustion (AFBC) system. The program title, "System Design Study to Reduce Capital and Operating Cost and Bench Scale Testing of a Moving Distributor, AFB Concept," is a good description of the general objective of the program. The specific objective was to compare the UAFBC with the conventional AFBC in terms of normalized steam cost. The boilers were designed for 150,00 lb/hr of steam at 650 psig and 750°F. The reference coal used in the analysis was Pittsburgh No. 8 coal with a sulfur content of 4.3% and a higher heating value of 12,919 Bru/lb. The analysis assumed a plant life of 20 years and a discount rate of 15%. The UAFBC systems included the usual elements of the conventional cola-fired AFBC steam plant, but the coal preparation sysbsystem for the UAFBC was considerably simpler because the system can use "run-of-mine" coal. The UAFBC boiler itself consisted of a staged-combustion fluidized-bed, superimposed over a static bed, the latter supported by a moving distributor. It incorporated a fines burnup combustor, an entrained reciculating gas clean-up bed, and conventional convection boiler. The key features of the UAFBC design were: High fuel flexibility; low NO/sub x/ emission; and superior turndown capability. 30 refs., 52 figs., 12 tabs.

45643 **(DOE/MC/21289—2064) Evaluation of calcium impregnated coal as a fuel for turbine combustors. Final report, September 1984-November 1985.** Reuther, J.J.; Condle, H.N.; Webb, P.R.; Feldmann, H.F. (Battelle Memorial Inst., Columbus, OH (USA)). Apr 1986. Contract AC21-84MC21289. 95p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86014207.

The objectives of this research program were two-fold: to experimentally determine the comparative in situ SO_x, NO/sub x/, and particulate-controlling capacity of calcium-doped coal under simulated combustion turbine conditions as a function of pressure, firing temperature, raw coal organic sulfur content, molar calcium/sulfur ratio, calcium source, and calcium loading technique, and to analytically determine the technical and economic feasibility of directly firing calcium impregnated coal in a combustion turbine. The calcium-doped bituminous coals consisted of high-sulfur Illinois No. 6 that had been premixed with various limes using either a proprietary Battelle process or simple physical mixing. The calcium-impregnated coal is called Battelle Treated Coal (BTC). The simulated turbine combustion conditions consisted or super-atmospheric pressure (4 to 5 atm), ultra-high excess air (10 to 15% excess oxygen), variable firing temperature (1800 to 2100°F), and high-carbon conversion (98+%). Battelle has operated a pulverized coal-fired facility that essentially simulates combustion turbine conditions. This simulator has proven to be of practical value in research concerned with the screening of coal fuels for advanced combustion turbines. Specifically, it has demonstrated that at low levels of calcium impregnation (Ca/S <2), increasing superatmospheric pressure (about 4 atm), high excess air conditions (15% excess O_2), short residence times (<250 milliseconds), and typical firing temperatures (2100°F), the use of BTC does the following during turbine combustion: improves ignition and stability, shortens char burnout time, relaxes materials problems, reduces internal deposition, reduces internal erosion, reduces internal corrosion, and simultaneously controls SO_x, NO/sub x/, and RO/sub x/ emissions. 35 refs., 12 figs., 15 tabs.

45644 **(DOE/PC/70794—7) Effect of energy feedback mechanisms on the oxidation rate of pulverized coal. Quarterly technical report, March 1-May 31, 1986.** Haussmann, G.; Krewson, S.; Kruger, C.H. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jul 1986. Contract FG22-84PC70794. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013317.

An experimental test was performed to extend the parameter range covered in the Stanford flow-tube reactor to lower gas temperatures (and thus lower particle heating rates). This experiment is intended to complement modeling efforts on the localized oxidation of pyrolysis products, particularly "tarry volatiles", during the early stages of pulverized coal combustion. Two important parameters of interest are the bulk gas oxygen concentration, and the particle heating rate. The effect of the particle heating rate is expected to be observed through its influence on the distribution and yield of pyrolysis products. The determination of this effect is the limiting factor at the current stage of this investigation, since this information is a necessary input into the diffusion-limited shrinking sphere model for tar oxidation which has been developed. This model has shown a reasonable prediction of the oxygen concentration depend-

ence for the carbon conversion rates at one gas temperature, 1750K. The application of this model to a range of temperatures is not yet possible due to the lack of information on the effect of the heating rate (i.e., gas temperature) on the tar yield. Future efforts will be centered around the measurement of tar yields through the examination of particle samples oxidized at a variety of bulk gas temperatures. The analysis of micro-samples for carbon, hydrogen, and ash content will also be performed. The ultimate goal of this model will be to understand the carbon conversion rates observed in the Stanford flow-tube reactor, and to assess the degree to which energy feedback contributes to the high reactivities observed. 6 figs.

45645 **(DOE/PC/71504—5) Operation and maintenance of DOE/PETC combustion test facilities. Quarterly technical progress report, April 1-June 30, 1986.** (Gilbert/Commonwealth, Inc., Reading, PA (USA)). 1986. Contract AC22-85PC71504. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014732.

Duties in the areas of computer data entry and data analysis were added to G/C responsibilities. Testing was conducted in all three tasks under the Alternative Fuels Research and Development Program. Both shakedown and parametric testing in the residential hot-water boiler were completed and design and modifications were begun for the next test series to be conducted in the residential warm-air furnace. Shakedown testing of the newly installed commercial cast-iron boiler was completed and parametric testing was begun. Installation of a commercial dense-phase pulverized-coal (PC) transport system and experimental PC burner in the Industrial Boilers/Furnace test facility was completed and shakedown testing was begun. In the Flue Gas Cleanup Research and Development Program, testing was completed in both the NOXSO and Copper Oxide Process test facilities. Testing continued as directed in the Dry Injection Process PDU. Design and construction of an integrated test facility for Advanced Separation Techniques progressed. In the Advanced Research and Technology Development Program, design and construction progressed on the laser development laboratory for the Ash Effects task and the drop tube furnace facility for the Global Char Combustion Kinetics task. Responsibility for analytical chemical analyses was added to the task covering Coal Preparation and Standards Laboratory support. The Advanced Combustor Technology Program was resumed in the middle of this report period. Preparation of the slagging combustor neared completion and design of the coal-water mixture feed system and sorbent injection system continues. Testing in the Tunnel Furnace was completed under prior task requirements. Support for the Coal Preparation Testing Laboratory was provided.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 45616, 45638

45646 **(PB—86-210507/XAB) Assessment of development and production potential of federal coal leases. Volume 2. Working papers. Part E, Vol. 1. Development and production potential of undeveloped federal coal leases and preference-right lease applications in the Powder River Basin and other Wyoming coal basins: Wyoming task force report. Working paper.** Boulding, J.R.; Pederson, D.L. (Office of Technology Assessment (U.S. Congress), Washington, DC). Jun 1984. 332p. NTIS, PC A15/MF A01.

This report was written for OTA and covers development and production potential of undeveloped federal coal leases and preference-right lease applications in the Powder River basin and other Wyoming coal basins: Wyoming task force report.

45647 **(PB—86-210515/XAB) Assessment of development and production potential of federal coal leases. Volume 2. Working papers. Part 1, Vol. 2. Analysis of federal coal leases in mine plans: detailed summaries of mine plans and lease blocks in Colorado, New Mexico, and Utah.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jun 1984. 361p. NTIS, PC A16/MF A01.

This volume contains papers written for OTA to assist in preparation of the report An Assessment of Development and Production Potential of Federal Coal Leases. Analysis of Federal Coal Leases in Mine Plans: Detailed Summaries of Mine Plans and Lease Blocks in Colorado, New Mexico, and Utah.

0160 Health And Safety

REFER ALSO TO CITATION(S) 45734

45648 **(PB—86-209483/XAB) Dual-wavelength light sources. Research report, October 1982-October 1985.** Boos, R.T.; Egan, W.D.; Elliot, R.A.; DeFreeze, R.K. (Bethlehem Steel Corp., PA (USA)). Oct 1985. 162p. NTIS, PC A08/MF A01.

This is a report on research directed toward the development of a coal-mine methanometer. The project encompassed two tasks. The first was a study conducted to determine if room-temperature injection lasers could be used as the source for a DIAL methanometer for coal-mine applications. As part of that study, prior DIAL measurements of methane were reviewed and the measurement technique explored in general. The second task was the design and fabrication of an external grating cavity to reduce the bandwidth of the injection lasers.

45649 **Regional measurement of ventilation and perfusion to detect subtle lung abnormalities in coal miners.** Susskind, H.; Liu, J.; Brill, A.B. (Brookhaven National Lab., Upton, NY). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **45**: No. 3, 392(1 Mar 1986). (CONF-8604222—).

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

The relationship between regional pulmonary ventilation (V) and perfusion (Q) uniquely determines the amount of gas exchange that occurs in the lungs. Therefore, the pixel-by-pixel distributions of V and Q were measured with continuously inhaled Kr-81m and i.v. injected Tc-99m MAA, respectively, in a group of 71 subjects exposed to coal dust and then compared with those from a control group of 9 healthy volunteers. Each subject sat upright with his back against a large-field-of-view scintillation camera; 500,000 count images were obtained, analyzed by computer, and then displayed in a 64 x 64 matrix. Individual pixel values of V and Q were correlated by a best-fit regression line, whose slope was proportional to the overall V/Q ratio. The slopes of individual groups of nonsmokers, ex-smokers, and smokers (0.83-0.85) were significantly greater ($p < 0.02$) than the slope of the controls (0.70 +/- 0.07). In addition, the authors found that the skewness of plots of frequency distribution of V/Q and of V and Q vs V/Q for the individual patient groups was statistically different from that of the normals ($p < 0.01$). Statistical analysis of local and Q values therefore appears to be a potentially useful, non-invasive method to evaluate subtle regional lung impairment.

02 PETROLEUM

45650 **(IFP-RA—1985) Institut Francais du Petrole 1984. Annual progress report.** (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 1985. 68p. (In French). NTIS (US Sales Only), PC A04/MF A01. File Number DE86752842.

In this progress report research, development in valorization concerning exploration, exploitation, production, refining, petroleum chemistry, energy conservation, personnel training, documentation are reviewed.

0202 Geology And Exploration

45651 **(NP—6901586) Development of a predictive model for corosity distribution in the Smackover Formation of southwest Alabama. Final report, project year 1984-1985.** Benson, D.J. (Alabama Univ., University (USA). Dept. of Geology). 7 Mar 1986. 91p. School of Mines and Energy Development, Univ. of Alabama, Tuscaloosa, AL 35486. File Number TI86901586.

Analyses of samples from 108 cores indicate that the Smackover in southwest Alabama was comprised of seven different depositional lithofacies. Appreciable amounts of depositional porosity were associated only with the oolitic grainstone (30 to 40% porosity), skeletal-peloidal grainstone/packstone (10 to 20% porosity), and algal boundstone (10 to 20% porosity) lithofacies. Depositional porosity was significantly modified by post-depositional diagenesis. Primary porosity was occluded by eogenetic and mesogenetic cementation and significant amounts of mechanical and chemical compaction. Secondary porosity was created by fabric selective eogenetic dissolution, brine reflux dolomitization, and nonfabric selective mesogenetic dissolution. Ultimate porosity is one or a combination of four types: interparticulate, moldic, vuggy, and intercrystalline. Dolomitic intercrystalline porosity, which includes both simple intercrystalline porosity and oversized intercrystalline porosity formed through dissolution of included anhydrite, is the most common pore type in the Smackover of southwest Alabama. Porosity ranges from less than 5 to 22% with permeabilities of less than .1 md to 100 md. Porosity vs depth crossplots show that while porosity does decrease with increased depth, the Smackover in southwest Alabama possesses significant amounts of reservoir grade porosity (>5%) at depths as great as 18,500 feet. In general, porosity in the Smackover of southwest Alabama is most common along the updip margin of the unit and across the paleohighs. The crests and flanks of the paleohighs offer the most promise for future hydrocarbon exploration since intercrystalline, vuggy, and moldic porosity are all common across the paleohighs. 27 refs., 20 figs., 1 tab.

45652 **Physical modeling of microscopic rock-pore heterogeneities.** Trygstad, J.C.; Ehrlich, R.; Wardlaw, N.C. (Sohio Petroleum Co.). pp 151-166 of Proceedings of the SPE/DOE fifth symposium on enhanced oil recovery. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-860402—).

From 5. SPE/DOE joint symposium on enhanced oil recovery; Tulsa, OK, USA (19 Apr 1986).

Two existing technologies have been merged to investigate the heterogeneity of rock-pore geometry and its influences on pore-level, multiphase fluid movement. Rock-Pore Modeling uses Petrographic Image Analysis (PIA) to computer-generate, from thin sections, black and white images of selected parts of a rock's pore system. These images are combined or used alone as templates for fabricating glass micromodels. Multiphase fluid flow experiments in these transparent glass micromodels provide a means of assessing the effects of various types of pore structure on fluid displacement under known and controlled conditions. Each template demonstrates in two dimensions textural heterogeneities present in the thin sections. Such heterogeneities include the geometry and size-distribution of selected parts of the pore system, including oversized pore elements, micropore elements, and pore connections. Mineral heterogeneities such as the distribution of carbonate cement are also recorded. Multiphase fluid flow in glass micromodels that are made from the templates is influenced by these pore and mineral textures.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 45652, 45676, 45678

45653 **(DOE/BC/10744—8) Reservoir characterization for numerical simulation. Final report.** Lake, L.W.; Scott, A.J.; Kocurek, G.A. (Texas Univ., Austin (USA)). Jun 1986. Contract AS19-82BC10744. 237p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86000285.

This report discussed the accomplishments of a research project dealing with quantitative reservoir description. The report has four major areas concerning: (1) a proposed reservoir description scheme; (2) a generalized statistical approach; (3) the connection between geology and statistics; and (4) how statistical descriptions affect fluid flow. Section III proposes the use of a power transformation to describe distribution functions. The transformation is theoretically motivated from a series or parallel arrangement of permeability layers and can be shown to encompass all of the single-population distributionss which characterize permeability. The power of the transformation can be determined only from the original data. Section III also shows that central tendency estimation and correlataion are both improved when the power transformation is used. In Section IV we attempt a correspondence between statistical indicators of permeability and geology. In two actual reservoir settings - fluvial and eolian sandstones - we found permeability to be controlled by stratification type, the primary depositional mode. The connection is quantitatively established from permeabilities measured in the field. The last section discusses two aspects of fluid displacements: the importance of the correlogram and volume averaging. We find that correlation in permeability can be used to classify mixing in displacements as flux, dissipative or capacitative dominated. The work on volume averaging shows that stabilized average fractional flow curves exist and can be used to lump point properties into grid block averages. 35 refs., 95 figs., 4 tabs.

45654 **(DOE/MC/16426—19) Mobility control for CO_2 injection. Final report, May 15, 1981-January 31, 1986.** Heller, J.P. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Aug 1986. Contract AC21-81MC16426. 138p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86000293.

This report gives an overall description of a Mobility Control Test of CO_2-Foam, performed in Pennzoil's Rock Creek Field of Roane County, West Virginia. The test did not produce any oil and was unfortunately not as definitive as had been wished. In particular, it did not give an unequivocal answer to the major question that had been asked - "What is the effectiveness of such a simulataneous injection of dense CO_2 and surfactant solution in suppressing viscous instability of the displacement front in order to improve the performance and efficiency of CO_2 floods." Despite this relative silence with respect to the most important question, the test did yield some results which can be of use to the industry. The first of these is that it is possible to inject dense CO_2 and surfactant solution simultaneously into a regular injection well. The reduced injectivity can be interpreted as due to reduced mobility of CO_2-foam, as an injection fluid with an apparent viscosity about 2 1/2 times that of water. The second test result of some interest is that the simultaneous injection of surfactant with the CO_2 was apparently successful in retarding the formation of viscous fingers and early breakthrough of CO_2 into a producing observation well only 75 feet away. The report gives details on related research and operating projects, on the design of all features of this test, on the chronology of injection and sampling, and on the test results. In addition, three extensive appendices give descriptions of related computer calculations of expected flooding patterns, of results to be expected from the Point Dilution Method and in the distribution of tracer concentration in the formation after a period of radial flow from the injection well. 25 refs.

45655 **(DOE/SF/11564—17) Thermal injection well falloff testing, SUPRI TR-33.** Walsh, J.W. Jr. (Stanford Univ., CA (USA). Petroleum Research Inst.). Aug 1986. Contract AC03-81SF11564. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86000286.

This study was conducted to find field case histories from which the swept volume could be determined from pressure transient tests at thermal injection well. Knowledge of the swept volume permits calculation of important economic parameters including the fuel concentration in a combustion test and heat loss in a steamflood. In an earlier study, a pressure transient model of a two-region reservoir was solved analytically and results demonstrated that in principle, both the permeability-thickness and the swept volume may be determined from a pressure transient test. A typical falloff curve consisted of an initial semilog straight line, a transitional period, and finally, a second semilog straight line. The transition period was found to contain a pseudosteady-state Cartesian straight line whose slope was related to the swept volume. Several sets of field test data were examined to verify the existence of the Cartesian straight line. In order that the swept volume may be calculated from the slope of the Cartesian straight line, the average reservoir pressure and temperature in the swept zone must be estimated. The average pressure is the early-time flattening of the pressure curve on a semilog graph. The average temperature in a steamflood can be estimated from the average pressure, but average temperature must be calculated for combustion. One method of calculation involves a heat balance which includes both the heat gen-

erated by combustion and the heat loss to the overburden. Several case histories are presented from both in-situ combustion and steamflood projects. An investigation for each case history shows the information that may be obtained from pressure transient tests. Pressure transient testing of the injection well is useful in evaluating and controlling the performance of thermal recovery projects.

45656 **Lab data aid design and evaluation of polymer floods.** Goodlett, G.O.; Honarpour, M.M.; Carroll, H.B.; Sarathi, P.S. (National Institute for Petroleum and Energy Research, Bartlesville, OK). *Oil and Gas Journal;* 84: No. 26, 82-90(30 Jun 1986).

Certain laboratory methods and measurements are essential for determining the critical parameters for designing and evaluating polymer floods. This article deals with scaling laws and the selection of core material to be used for replication of reservoir conditions. Automation can significantly improve the productivity of laboratory core tests. Basic objectives of automation include rapid turnaround time for experiments, flexibility, and convenient data analysis and presentation. Coreflooding tests, because of their time-consuming nature, are ideal candidates for automation. At the upstream end of the system, a five-way, electrically operated ball valve is used for selection of fluids for injection into the system.

45657 **Effect of mixed-chain-length surfactants on fluid displacement in porous media by in-situ foaming process.** Sharma, M.K.; Shah, D.O.; Brigham, W.E. (Univ. of Florida). *SPE Reservoir Engineering;* 1: No. 3, 253-260(May 1986).

A laboratory study was designed to improve fluid displacement efficiency in porous media by an in-situ foaming process and to determine the effect of mixed surfactant chain length on surface properties of foaming solutions, bubble size, breakthrough time, and fluid displacement in porous media. The authors screened various mixed surfactant systems, such as sodium dodecyl sulfate and alkyl alcohols. Maximum breakthrough time and fluid displacement efficiency were observed when both components of the mixed foaming system possessed the same chain length. Results were compared with data obtained using water, brine, and sodium dodecyl sulfate alone. The microscopic studies revealed that the order of bubble size measured outside the porous medium for various mixed surfactants was indeed maintained in a micromodel. The increase in the porous medium length improved breakthrough time and fluid displacement efficiency in sandpacks and in Berea cores. Mixed surfactant systems showed a correlation among surface properties of foaming solutions, bubble size, breakthrough time, and fluid displacement efficiency in a porous medium. Maximum foaminess, minimum bubble size, minimum surface tension, maximum surface viscosity, maximum breakthrough time, and maximum fluid displacement efficiency were observed when the two components of the surfactant system had the same chain length.

45658 **Effect of crude-oil-induced wettability changes on oil recovery.** Morrow, N.R.; Lim, H.T.; Ward, J.S. (New Mexico Petroleum Recovery Research Center). *SPE Formation Evaluation;* 1: No. 1, 89-103(Feb 1986).

Displacements in strongly water-wet cores are compared with results of similar tests for a mixed wettability condition induced by a selected crude oil. Cores exposed to crude oil showed weakly water-wet imbibition behavior and 30 to 65% improvement in microscopic displacement efficiency. Other characteristics included clean breakthrough and low relative permeability to water at residual oil saturation. Flow visualization experiments with crude oil in micromodels showed improved oil recovery from pore bodies with oil trapping in pore throats. Capillary numbers for mobilization of residual oil from weakly water-wet systems were higher than for strongly water-wet systems. Contact-angle measurements showed that adsorbed transition metal ions at a high-energy surface could have a dominant effect on wetting behavior.

45659 **Alkaline flood prediction studies, Ranger VII pilot, Wilmington Field, California.** Mayer, E.H.; Breit, V.S. (THUMS Long Beach Co.). *SPE Reservoir Engineering;* 1: No. 1, 9-22(Jan 1986).

This paper discusses the design of a simulator to model alkaline displacement mechanisms, along with the current understanding of in-situ caustic consumption. Assimilation of laboratory coreflood and rock consumption data, and their use in one- and two-dimensional (1D and 2D) limited area simulations and in three-dimensional (3D) models of the entire pilot project are given. This paper also reports simulation studies of alkaline flood behavior in a small 2D area of a field for various concentrations, slug sizes, long-term consumption functions, and two relative-permeability adjustment mechanisms. The scale-up of 2D simulation results and their use in a 271-acre [1096.7-ha], seven-layered, 3D model of the pilot are also discussed and 3D simulator results are compared with initial field alkaline flood performance. Finally, recommended additional applications of the simulator methods developed in this pilot and in other alkaline floods are discussed.

45660 **A note on the application of the theory of coherence to surfactant flooding.** Saneie, S.; Yortsos, Y.C. (Univ. of Southern California). *SPE Reservoir Engineering;* 1: No. 1, 23-28(Jan 1986).

Previous studies have shown that in the absence of dispersion, a surfactant flooding process is amenable to a simplified solution by the method of coherence. The development of the solution requires the construction of composition paths that are obtained numerically by the integration of ordinary differential equations. In this paper, the authors show that in the particular case when all tie lines in the triangular phase diagram originate from a single point on the w,o axis, the construction of the composition paths can be considerably facilitated, because the tie lines obey the condition λ_1=constant (contact discontinuity). It is shown that this exceptional case corresponds to a phase equilibrium relationship of the form (C/sub V32/C/sub V11/-C/sub V12/C/sub V31/)/(C/sub V31/-C/sub V32/)=K. This relationship was originally proposed to describe the thermodynamics of concentrated solutions. The connection of this relationship to a generalized Hand-plot model is also discussed.

45661 **A nonequilibrium description of alkaline waterflooding.** deZabala, E.F.; Radke, C.J. (Univ. of California). *SPE Reservoir Engineering;* 1: No. 1, 29-43(Jan 1986).

Alkaline waterflooding is complicated because the surfactant species are generated in-situ from acidic components in the crude oil rather than injected externally. The authors previously outlined an equilibrium displacement theory that captured the essential features of the process. Assumption of local equilibrium, however, does not allow for a careful examination of the complex transport and kinetic phenomena that occur. Non-equilibrium theory models the pertinent mass-transfer and kinetic resistances affecting interfacial tensions (IFT's) during displacement of oil-recovery efficiency. The model shows that when natural acid in a trapped oil blob contacts alkali, it diffuses to the interface, adsorbs, reacts with alkali, desorbs, and convects into the bulk aqueous phase. They quantify these transport steps, calculate concentration profiles in the oil and flowing aqueous phases during a linear displacement, and to determine how transient tension behaves as a function of time and distance. Mass transfer resistances are insignificant, but sorption resistances at the oil/water interface affect the transient evolution of IFT during alkaline displacement. Interfacial sorption barriers are modeled with first-order kinetics. Desorption resistances may be quite large, so low IFT's may not be established in typical laboratory-scale cores. Reversible or irreversible surfactant adsorption or reservoir rock is detrimental to alkaline water-flooding. Rock adsorption reduces the amount of surfactant available to the oil/water interface and may raise the IFT to levels that are ineffective in mobilizing residual oil globules. Most importantly, they provide a conceptual framework to design a successful alkaline waterflood.

45662 **Multicomponent CO_2/water/hydrocarbon phase behavior modeling: A comparative study.** Kuan, D.Y.; Kilpatrick, P.K.; Sahimi, M.; Scriven, L.E.; Davis, H.T. (Univ. of Minnesota). *SPE Reservoir Engineering;* 1: No. 1, 61-72(Jan 1986).

Phase behavior predictions of the Peng-Robinson (PR) equation and the Kleintjens-Koningsveld (KK) equation, a lattice-gas model, are compared for pure CO_2, water, methane, n-butane, n-octane, n-decane, and several binary and ternary mixtures of these components. The KK equation is more accurate than the PR equation for predicting the saturated liquid densities of pure fluids. The

two equations are comparable in predictions of binary pressure/composition phase diagrams and ternary-composition phase diagrams. Thus for these properties, the PR equation is preferred because it is a simpler equation, has fewer adjustable parameters, and has parameters available for more systems than the KK equation.

45863 **A comparison of methods for the representation of three-phase relative permeability data.** Parmeswar, R.; Maerefat, N.L. (National Institute for Petroleum & Energy). pp 151-164 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

In this study, three-phase relative permeability data, reported previously by five other investigators are represented by a power law functional form with seven parameters to be estimated for each of the phases present. In this new approach, it is assumed that the relative permeability of a given phase is a function of the three fluid saturations. Results from the seven-parameter equations fit the experimental data throughout the three-phase range within experimental error (0.52%). To illustrate the accuracy of the isoperms predicted by the parametric method, these isoperms were compared with isoperms obtained by a graphical contouring technique. The graphical contouring technique uses a collection of local interpolation functions to calculate isoperms from experimental data and to plot on a triangular graph. This procedure eliminates errors resulting from subjective bias and is a true representation of the experimental data since it passes through all data points.

45864 **Experimental and theoretical investigation of time-setting polymer gels in porous media.** Hubbard, S.; Roberts, L.J.; Sorbie, K.S. (U.K. Atomic Energy Authority). pp 447-470 of Proceedings of the SPE/DOE fifth symposium on enhanced oil recovery. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-860402—).

From 5. SPE/DOE joint symposium on enhanced oil recovery; Tulsa, OK, USA (19 Apr 1986).

This paper studies the kinetics of the xanthan-chromium gel system both in bulk and in non steady state injection into cores. The central objective of this work is to perform well characterised core flow experiments with a simple gelling system which may then be mathematically simulated in order to obtain a detailed knowledge of the processes that are occurring. This is a first step in formulating models which may be used to simulate gel treatments at the field scale. In some of the experiments, γ-labelled ^{51}Cr is used so that in situ chromium profiles may be observed during the gel emplacement stage in a core. Detailed information from both in situ and effluent measurements is required in order to distinguish between different possible kinetic/transport models for the complexed xanthan-chromium products. A generalized multicomponent transport equation including terms describing the crosslinking reaction is used to simulate some of the experiments. Three alternative models of the kinetics used in the transport equation are applied to the experiments in sandstone cores. This simulation work leads to a number of specific conclusions on possible models of gel kinetics in porous media.

45865 **A model for prediction of recovery and pressure history for 2-D displacement of oil through porous media by gas/surfactant.** Mahmood, S.M.; Tarig, S.M.; Brigham, W.E. (National Institute for Petroleum & Energy). pp 325-336 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

The problem of predicting recovery and pressure behavior during gas/surfactant solution flooding is too complex to be treated analytically with the current state of knowledge. In the early stages of such displacements, the gas and surfactants are macroscopically dissociated and segregated, each flowing in separate channels. The in situ generation of foam does not seem to initiate until a certain mass of surfactant has been injected. Frontal advance theories such as the Buckley-Leverett theory or the Dietz model assume the injected fluid to be single phase, homogeneous, and non-reactive. Since these criteria are not met by the flow of gas and surfactant solution, these theories fail to accurately predict the recovery performance of such displacements. Based on the observations made during a series of experiments on a scaled-model, a semi-analytical model is proposed to predict the oil recovery and pressure history from two-dimensional (x,z) systems undergoing gas/surfactant injection. The model is based on the concept of a combination flood, in which gas/foam and surfactant solution flow in separate gravity tongues. The gas/foam displacement is assumed to follow the Buckley Leverett theory, whereas the surfactant displacement follows the Dietz model. The displacements through these tongues are mutually dependent and, therefore, these theories are combined at each stage. The predictions from the model gave a good match with the experimental results for a fairly broad range of operating conditions. The semi-analytical approach adopted in developing the combination drive model has potential for application to certain other types of frontal behaviors.

45866 **Comparison of steady and unsteady-state flow of gas and foaming solution in porous media.** Huh, D.G.; Handy, J. (Univ. of Southern California). pp 351-362 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

Foam has been successfully used in many areas of the petroleum industry. Since the application of foam was first proposed for the process of gas phase injection, most studies were made with respect to the properties of bulk foam. Although it seems to be unreasonable to expect flow of bulk foam through porous medium, very few papers have reported on the relative permeabilities of fluid distributions in the presence of foaming agent, especially in consolidated sand. Relative permeabilities of foaming agent solution-nitrogen gas were measured by both steady and unsteady state methods using fired Berea sandstones. These were compared with the reference relative permeability of brine-nitrogen gas. The permeability reduction factor was calculated from the ratio of the gas permeability in the presence of foaming agent to that in the absence of foaming agent. The effects of surfactant concentration and pressure gradient were investigated.

45867 **Solubility and extraction in multiple-contact miscible displacements: Comparison of N_2 and CO_2 flow visualization experiments.** Bahralolom, I.M.; Orr, F.M. (New Mexico Petroleum Recovery Research Center). pp 363-370 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

Results of secondary and tertiary displacements of Maljamar crude oil by N_2 and CO_2 are compared to examine the effects of solubility and extraction on local displacement efficiency. The flow visualization experiments were performed in pore networks etched in glass plates. In those experiments, the much higher solubility of CO_2 in the oil caused only marginal improvement in displacement efficiency over that observed for N_2, which was much less soluble. At pressures high enough that CO_2 extracted hydrocarbons efficiently, however, displacements were much more efficient. Secondary and tertiary displacements in a more heterogeneous glass model are also compared. In a secondary displacement with high solubility but low extraction, adverse capillary and viscous effects limited the area swept to preferential flow paths. High CO_2 solubility did not appear to have significant effects. When water was present in tertiary displacements with efficient extraction and high solubility, combined effects of viscous instability, capillary forces and heterogeneity sharply reduced sweep efficiency below that observed in secondary displacements in the same model.

45668 **Measurements and correlations of the physical properties of CO_2-heavy crude oil mixtures.** Chung, F.T.H.; Jones, R.A.; Nguyen, H.T. (National Institute for Petroleum and Energy Research). pp 371-380 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

Experiments were performed to determine the viscosity reduction, swelling factor, and CO_2-solubility for heavy oils saturated with carbon dioxide. Measurements of viscosity and density at temperatures from 75° to 200°F and pressures up to 5,000 psia were made on nine crude oils ranging from 10° to 20° API gravity. The oils were then saturated with CO_2 over the same range of temperatures and pressures, and the solubility of CO_2 was measured along with the viscosity and density. The solubility of gaseous CO_2 in oil increases with pressure, while the solubility of liquid CO_2 is weakly pressure dependent. The swelling and viscosity reduction of oil are related to the quantity of CO_2 dissolved. Saturation of crude oil with CO_2 at or above the CO_2 critical pressure reduced crude oil viscosity to less than one-tenth of its original value and its volume increased by 20 percent. Changes in viscosity and volume of this magnitude can significantly improve the mobility of heavy oils and increase oil recovery over that recovered by natural depletion.

45669 **Experimental and simulation studies of laboratory in-situ combustion recovery.** Onyekonwu, M.O.; Pande, K.; Ramey, H.J.; Brigham, W.E. (Univ. of Port Harcourt). pp 483-496 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

This paper discusses the effects of some parameters on the in-situ combustion process. The paper is in two parts. The first part discusses a laboratory in-situ combustion tube run. Important design parameters such as fuel concentration, air requirement, oxygen utilization efficiency and combustion front velocity may be determined from the analysis of laboratory tube run data. The second part of the paper discusses numerical simulation of the laboratory tube run and results from in-situ combustion simulation studies. A thermal simulator was used to investigate the effects of relative permeability, rock thermal conductivity, heat losses, API gravity of oil, initial conditions, oxygen concentration, and other parameters on fuel availability and combustion front velocity. Results from simulation studies show that oil viscosity, residual oil saturation (gas/oil system) and oxygen mole fraction in the injected gas should have the greatest effect on fuel availability. Relative permeability data and rock thermal conductivity also affect the amount of fuel available for combustion. Factors which may cause an increase in combustion front velocity may also cause an increase in the amount of fuel burned if the heat front moves slower than the combustion front. The use of a thermal simulator for this study made it possible to study a wide range of parameters which would involve a substantial effort to investigate experimentally.

0205 Products And By-products

REFER ALSO TO CITATION(S) 45688

45670 **(AD-A—167448/0/XAB) Chemistry of deposit formation in distillate fuels.** Hazlett, R.N.; Power, A.J.; Kelso, A.G.; Solly, R.K. (Materials Research Labs., Ascot Vale (Australia)). Jan 1986. 66p. (MRL-R—986). NTIS, PC A04/MF A01.

The chemistry of deposit formation in distillate fuels was investigated at 65 and 80 C for time peroids equivalent to up to four years ambient storage. The chemical environment was varied by using different fuels, fuel blends, deposit promoters, and stabilzers. Blends of light cycle oil (LCO) in straight-run automotive distillate oil (ADO) were studied in most detail. A variety of carboxylic acids, a sulfonic acid, thiophenol, and caustic extract from LCO (primarily phenols) increased deposit formation, some very dramatically. For the carboxylic acids, a linear relationship was found between the hydrogen ion concentration calculated from pK/sub a/ values for water solutions and the amount of deposit formed. These acids enhanced deposit formation by catalytic action and are not incorporated into the deposit. Dodecylbenzenesulfonic acid and thiophenol were both strong deposit promoters, the latter deriving its major activity through partial conversion to benzenesulfonic acid during fuel stress. The phenols in the LCO caustic extract react via oxidative coupling to increase molecular size and develop low solubility in the fuel. A tertiary aliphatic amine stabilzer was effective for reducing the amounts of deposits from most stressed fuels and from all blends tested.

45671 **(PB—86-209038/XAB) Microbial problems in connection with storage of jet fuel in rock caverns. Methods to inhibit development of corrosive fuel.** Norqvist, A.; Edlund, A.; Roffey. (Office of International Cooperation and Development (USDA), Washington, DC). Apr 1986. 44p. (In Slovene). (FOA-A—40054-B4). NTIS, PC A03/MF A01.

Problems with long-term storage of jet fuel in rock caverns have during the last years been observed. The problems have mainly been concerned with the accumulation of corrosive compounds in the fuel. Studies in laboratory model systems were carried out in order to understand which factors are important in causing the problems. The rate of groundwater leaking in, the oxygen and sulfate concentration in the bedwater, the amount of sediment, and the temperature were shown to be some of the more-important factors. With the aim to find some suitable methods to prevent the problems from arising, studies in model systems were also carried out. Oxygenation of the bedwater or addition of a biodegradable biocide gave positive effects resulting in reduction of microbial activities and no development of corrosive fuel.

0209 Environmental Aspects

45672 **(PB—86-209145/XAB) Outer Continental Shelf environmental assessment program. Final reports of principal investigators. Volume 38.** (National Ocean Service, Anchorage, AK (USA). Ocean Assessments Div.). Apr 1986. 740p. NTIS, PC A99/MF A01.

This final report of a study of the environmental characterization of the North Aleutian Shelf nearshore region includes: characterization, processes, and vulnerability to development; and annotated bibliography and keyword index.

0230 Properties

45673 **(NIPER—178) Effect of weathering on octane quality for winter-grade gasolines.** Wares, R.N. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 31 Jul 1986. Contract FC22-83FE60149. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014656.

The experimental program at NIPER was initiated to provide information to make technical judgments on fuel, fuel specifications, and fuel conditioning requirements for a range of fuels that could be utilized in current light aircraft. This portion of the work is centered on determining the acceptability of motor fuels that have been weathered, causing loss of volatile components. Commercial auto gasolines from various locations are being surveyed in terms of volatility and octane quality - in both as received and after weathering conditions. Antiknock quality is being evaluated to assess the suitability of this variety of auto fuels for aviation applications. To date, experiments have been conducted with ten winter (January-February) fuels that were obtained from commercial suppliers representing various geographic (refining) areas in the contiguous 48 states. The fuels were tested in as received condition with no modifications to the existing vapor pressures. Similar fuel properties (octane ratings, distillation character, fuel composition) are also presented in the section dealing with test results. 15 figs., 12 tabs.

45674 Molecular characterization of nickel and vanadium non-porphyrin compounds found in heavy crude petroleums and bitumens. Fish, R.H.; Izquierdo, A.; Komlenic, J.J.; Reynolds, J.G.; Gallegos, E.J. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 2, 613(Apr 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

The isolation and identifications of vanadyl and nickel non-porphyrin complexes found in heavy crude petroleums and bitumens is a major goal of our joint petroleum chemistry program. The authors have isolated a new class of very polar nickel compounds present in several heavy crude petroleums and also in Gilsonite, a well known bitumen. The nickel complexes are thought to be naphthenic acid derivatives and data will be presented that supports this first identification of a metallo-non-porphyrin compound in any crude petroleum or bitumen. They also analyzed the vanadyl non-prophyrin compounds found in heavy crude petroleums by ESR spectroscopy to ascertain the heteroatom environment around the vanadyl ion. The identification of these metallo-non-porphyrin complexes will provide insights into their in-geochemical origin and have a profound effect on petroleum exploration and catalytic deactivation studies.

45675 Axial coordination in nickel and vanadium porphyrins: Transient and difference raman spectroscopy. Shelnutt, J.; Alston, K.; Findsen, E.; Ondrias, M. (Sandia National Labs., Albuquerque, NM 87185). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 2, 613(Apr 1986). (CONF-860425—). Contract AC04-76DP00789.

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

Nickel and vanadium tetrapyrroles occurring in coal and petroleum are of biological origin and their present day molecular structures provide a valuable chemical fossil marker of the diagenesis of the deposits. Both Ni- and V-porphyrins add axial ligands at the metal site. The authors have investigated the equilibrium properties and nanosecond dynamics of axial ligation in Ni(II)- and V(IV)-porphyrin complexes, Ni-porphyrin-reconstituted heme proteins, and Ni-porphyrin polymers using resonance Raman spectroscopy. The state of axial coordination is recognized by characteristic frequencies of Raman oxidation-state and core-size marker lines arising from the vibrations of the porphyrin ring, and the frequencies distinguish between 4-, 5-, and 6-coordination. For the Ni-porphyrins, 4- and 6-coordinate species are observed in coordinating solvents, while 5-coordinate Ni occurs only in the protein matrix. The axial ligand-Ni stretching mode frequency is influenced by the conformation of the protein matrix. Ligand affinity is affected by porphyrin structure, ligand basicity, and the porphyrin's environment. The authors also investigated photoinduced ligand-release and ligand binding kinetics using transient Raman spectroscopy. The protein matrix has a strong influence on the kinetics of ligand rebinding. For vanadium porphyrins, similar shifts in the marker lines characterize 5- and 6-coordinate forms.

45676 A study of crude oil composition during CO_2 extraction process. Wang, G.C. (Univ. of Alabama). pp 423-432 of Proceedings of the 56th annual California regional meeting of the Society of Petroleum Engineers. Volume 1. Richardson, TX; Society of Petroleum Engineers (1986). (CONF-8606136—).

From Numerical methods in fluid dynamics; Beijing, China (23 Jun 1986).

The extraction process of hydrocarbon from crude oil by CO_2 and the development of miscibility were simulated in a high pressure visual cell. Samples of the extracted crude oil as well as the enriched CO_2 vapor were withdrawn successively from the cell for composition analysis using a gas chromatograph. Three natural crude oils with gravities ranging from 17° to 45° API (sp. gr. 0.80 to 0.90) were chosen for the study. The results indicate that the CO_2-crude oil interactions can be divided into three stages: (a) CO_2 condensation, (b) extraction-condensation and (c) extraction. It was found that the amount of hydrocarbon being extracted was proportional to pressure or CO_2 density. Lighter components from C_5 to C_{20} were comparably easy to be extracted, however, heavier components up to C_{35} may also be extracted though in a relatively small quantity. For heavy crude oil containing low intermediates of C_5 to C_{20}, the extraction was inefficient at all conditions. Active and deep extraction may cause permeability damage due to excessive asphaltine deposition. Temperature has a great effect on CO_2 extraction. The extraction efficiency could be improved with reduced temperature. Best extraction was obtained when CO_2 was in liquid state.

45677 Use of laser light to measure surface tension. Longrigg, P. (Solar Energy Research Institute, Golden, CO). pp vp of Proceedings of the international congress on applications of lasers and electro-optics. Toledo, OH; Laser Institute of America (1985). (CONF-8511103—).

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

This paper describes a technique that utilizes an effective synthesis by a liquid meniscus of a right-angle prism, leading to what might loosely be termed an optical 'lever effect' or total internal reflection (TIR), upon a narrow beam of laser light from a He-Ne laser traversing a beaker of ordinary lubricating oil. This angular deflection can thereby be employed to determine contact angle and therefore the surface tension of a liquid. Meniscus geometry is an important parameter in crystal growth procedures. A non-intrusive or no contact probe detailing meniscus shape and geometry would be of considerable value in identifying the types of menisci associated with various crystal growth techniques. The measurment of interfacial tension at fluid interfaces together with the measurement of contact angle which is formed between the fluid interface and a restraining wall, is of primary importance in surface science metrology. Numerous techniques have been developed to make such measurements and the methods most often used include the de Nouy ring, Wilhelmy plate, and drop weight.

0240 Storage

REFER ALSO TO CITATION(S) 45671

45678 (PB—86-203833/XAB) Guidance document on evaluation of injection-well manifold monitoring systems. (Woodward-Clyde Consultants, Englewood, CO (USA)). Nov 1985. 54p. NTIS, PC A04/MF A01.

In the Underground Injection Control (UIC) Regulations, owners and operators of Class II hydrocarbon storage and enhanced recovery wells are allowed to monitor injection pressure, flow rate, cumulative volume, and the nature of the injected fluids on a field/project basis rather than on an individual-well basis through the use of manifold monitoring (40 CFR Section 146.23(b)(5)). Such a monitoring system may be used in cases of operation consisting of multiple injection facilities operating with a common manifold. Separate monitoring systems for each well would not be required provided that the owner/operator demonstrates to EPA's satisfaction that manifold monitoring is comparable to individual well monitoring. The purpose of the document is to develop technical guidance and ancillary criteria to enable EPA personnel to evaluate the effectiveness of such system proposals in meeting the regulatory requirements.

45679 (R-MECH—02/83) Results of numerical modelling of non-isothermal flows - flows produced by density gradients. Baerwolff, G.; Bungartz, H. (Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Mechanik). 1983. 74p. (In German). Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Mechanik.

In caverns under the earth-surface (for example storing of fossil fuel) and in furnaces of melting glass we can see convective fluid motion because of existing temperature- resp. density-gradients. This fact is described by the mathematical model of 'Boussinesq-approximation'. The obtained coupled nonlinear system of p.d.e. is solved by a finite difference method (two dimensional case) and by a GALERKIN-method (three dimensional case).

45680 **Experimental studies of oil withdrawal from salt cavities by freshwater injection.** Reda, D.C.; Russo, A.J. (Sandia National Labs.). *SPE Production Engineering;* **1**: No. 1, 75-81(Jan 1986). Contract AC04-76DP00789.

The U.S. Strategic Petroleum Reserve (SPR) program coordinates storage of crude oil in underground salt caverns. Oil removed from these caverns by the injection of water into a brine volume located beneath the oil will be recovered through a production pipe near the top of the cavern. The critical question concerning this procedure was whether the crude oil would protect the salt walls from dissolution on exposure to unsaturated brine following oil/brine interface passage. Oil/brine/salt interactions were investigated experimentally. Cylindrical cavities were created by hollowing out salt cores from one end, leaving the circular wall and bottom as an integral piece. In four experiments, a salt cavity was placed vertically in a pressure vessel and was filled with crude oil overlying a saturated-brine "pocket." The vessel was sealed and pressurized to actual SPR-cavern pressure. Fresh water was injected down a tube into the brine pocket, displacing the oil upward for recovery through a production tube. A traversable gamma-beam densitometer positioned above the initial saturated-brine/oil interface defined the presence or absence of salt dissolution (cavity shape change) during the transient oil-withdrawal process. Such measurements showed salt-wall recession immediately following interface passage in all tests; i.e., crude-oil adherence and/or penetration at the salt wall failed to protect the salt from dissolution when exposed to unsaturated brine. Measured post-test cavity shapes corroborated the transient results. Both transient and steady-state measurements were in good agreement with numerical predictions generated by SANSMIC (Sandia Solution-Mining Code) once "no oil-layer protection" was assumed.

45681 **Experimental studies of salt-cavity leaching by freshwater injection.** Reda, D.C.; Russo, A.J. (Sandia National Labs.). *SPE Production Engineering;* **1**: No. 1, 82-86(Jan 1986). Contract AC04-76DP00789.

Salt-cavity-leaching experiments were conducted in the laboratory in support of the U.S. Strategic Petroleum Reserve (SPR) program. Cavities of an initially cylindrical geometry were created by hollowing out salt cores from one end, leaving the circular wall and bottom as an integral piece. In three experiments, a salt cavity was placed vertically in a pressure vessel and its interior was filled with saturated brine. The vessel was sealed and pressurized to actual SPR-cavern pressure. Fresh water was injected down a tube into the cavity, while brine was removed simultaneously from the cavity through a withdrawal tube. Both direct (injection-below-withdrawal) and reverse (injection-above-withdrawal) leaching procedures were investigated for essentially the same flow rate conditions and total withdrawal time. A traversable gamma-beam densitometer was positioned between the injection and withdrawal locations in each case and was used as a nonintrusive diagnostic technique to investigate transient phenomena that occurred during the leaching and post-leaching (return to equilibrium) periods. Beam attenuation measurements yielded a quantitative measure of the total, time-integrated, salt-wall recession and the instantaneous, path-length-averaged, brine salinity. Final cavity shapes were measured by gamma-beam densitometry and by sectioning/micrometer techniques. Transient and steady-state measurements were compared with numerical predictions. Experimental results and numerical predictions were in good agreement.

0250 Combustion

45682 **(DGRST—81-D-0512) Formation of cenospheres by pyrolysis and oxydative pyrolysis of a monodispersed string of droplets of heavy fuel.** Lahaye, J.; Bomo, N.; Ladurelli, A.; Claus, M.; Escalier, J.C. (Delegation Generale a la Recherche Scientifique et Technique (DGRST), 75 - Paris (France)). Aug 1983. 100p. (In French). (DGRST—81-D-0513). NTIS (US Sales Only), PC A05/MF A01. File Number DE86752844.

A great amount of solid unburnts is produced by heavy fuel combustion. These solid unburnts are essentially soot and cenospheres which are spherical particles, generally hollow, between 100 microns and few hundred microns. Solid emission is very variable for different heavy fuels. The aim of this work is to limit cenosphere production during heavy fuel combustion. The main parameters are: fuel composition, droplet size, initial temperature of fuels, temperature, time of reaction, droplet gaseous environment. Cenosphere formation depends more on asphalten chemical structure than on asphalten content. Cenospheres are produced at much lower temperature than soot. Cenosphere is produced inside the droplet and not at the liquid/gas interface during hydrocarbon carbonisation. The thermal transfer model realized agrees with results obtained. 56 refs.

03 NATURAL GAS

0302 Geology And Exploration

45683 **(PB—86-215746/XAB) Exploration-production studies in newly drilled Devonian-Shale gas wells. Annual report, February 1, 1985-January 31, 1986.** Graham, R.L. (Graham (Reuben L.), Inc., Charleston, WV (USA)). Feb 1986. 63p. NTIS, PC A04/MF A01.

The Devonian shale has been recognized as an important source of gas in the Appalachian Basin. The program aids producers in the collection of reservoir data not normally collected and assists in the evaluation of the effectiveness of zone selection and stimulation designs and methods. The study should provide a fuller understanding of the relationships that affect productivity in the Devonian shale. The relationships between gas flows and geological features that control the production characteristics in the Devonian shale are being developed.

0303 Drilling, Production, And Processing

45684 **Membrane separation technology.** Stookey, D.J.; Patton, C.J.; Malcolm, G.L. New York, NY; American Institute of Chemical Engineers (1986). 8p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

Membrane separations of interest here are not to be confused with barrier separations of the type employed in the uranium enrichment plant at Oak Ridge, Tennessee. There isotopes of uranium hexafluoride were separated by the free-molecular or Knudsen flow of the gas mixture through the pores and orifices created within a porous nickel media which was sometimes referred to as a membrane. In barrier separation, an enrichment of gases of differing molecular weights is accomplished by the differing gaseous diffusion rates within the porous media. By contrast the membranes of interest here are thin, dense, continuous films, typically formed from polymers. The separation of species is accomplished by the dissolution of the gases in the polymer and their diffusion across the solid film thickness under a concentration gradient according to Fick's law. This process is commonly referred to as membrane permeation.

0306 Marketing And Economics

45685 **(PB—86-203114/XAB) Competitive position of natural gas: steel-reheat applications. Topical report, January 1985-May 1986.** Williams, J.H.; Koch, G.S.; McDermott, H.; Klareich, F.H. (Hagler, Bailly and Co., Washington, DC (USA)). May 1986. 159p. NTIS, PC A08/MF A01.

Steel-reheat market application profiles are developed for natural gas and other fossil-fueled furnaces as well as for electric-induction furnaces. Natural gas accounts for over 72% or, 135 of the 187 trillion Btu per year currently used for reheating steel prior to rolling or other forming operations. Future steel industry and technology trends are examined for potential impact on natural gas use and natural gas technologies. Beyond the global factors affecting the steel industry as a whole, further implementation of hot charging and direct rolling techniques could reduce the amount of fuel needed for reheat. New steel forming processes now under development seek to minimize the time and energy needed for reheat, and could place dramatically new requirements on gas-fueled reheat technologies. Although more costly, current electric induction heating technologies appear to be better positioned to take advantage of

these new processes. New R&D opportunities for the natural gas industry are discussed in the context.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 45678

45686 **(PB—86-213972/XAB) Multiple-fracture stimulation using controlled pulse pressurization. Final report, March 1983-December 1985.** Schrauf, T.; Sinha, K.; Van Buskirk, R.; Hanson, J. (Terra Tek, Inc., Salt Lake City, UT (USA)). Dec 1985. 88p. (TR—86-52). NTIS, PC A05/MF A01.

It has previously been established that multiple hydraulic fractures can be created from a single borehole by high-rate, high-pressure, pulsed-fracture treatment. It was the objective of the project to quantitatively understand the process by a combined experimental-theoretical program. A fracture initiation model was developed based on a coupled pore pressure-stress formalism and classical mode I flaw opening concepts. The dependence of fracture initiation on pressurization rate, peak pressure, and the physical parameters of the formation and frac fluid, which is contained within the formalism, is evaluated. A simple fracture propagation model has been used in conjunction with the fracture initiation model to aid in defining multiple fracture-experiment design parameters, and indicates that borehole storage effects can play a major role in initial fracture extension.

45687 **(PB—86-213998/XAB) Preliminary economic assessment potential for producing coalbed methane for the multiple coal seams completion project at Rock Creek. Topical report, March 1983-May 1986.** Schwerer, F.C.; Militzer, M.R.; Boyer, C.M. (United States Steel Corp., Monroeville, PA. Technical Center). May 1986. 116p. (REPT—76-H-088/089). NTIS, PC A06/MF A01.

The Multi-Seam project, located at the Rock Creek site in the eastern part of the Warrior Basin, Alabama, was initiated to develop, evaluate, improve, and communicate the technology required to produce methane from vertical wells completed into multiple coalbeds. The study evaluates the economic potential for commercial production of methane from multiple coal groups as encountered at the Rock Creek site based on data acquired from the project and state-of-the-art reservoir models.

45688 **(PB—86-217098/XAB) Geologic and reservoir characteristics of the Red Mountain coalbed-methane test site in the Piceance Basin. Topical report, April 15, 1983-January 31, 1986.** Seccombe, J.C.; Decker, A.D. (Resource Enterprises, Inc., Grand Junction, CO (USA)). May 1986. 102p. NTIS, PC A06/MF A01.

The Red Mountain Site, leased and operated by Resource Enterprises, Inc. is the focus of a six-year, multi-well project with a main objective to develop, improve, evaluate, and communicate the technology required to produce gas from deeply buried coal. To understand the parameters controlling coalbed gas production, project efforts are focused on a single coal reservoir (the Cameo Coal D Seam) at the test site. The report focuses on the evaluation of reservoir parameters controlling coalbed gas production and the geologic conditions influencing these parameters at the Red Mountain Site. The most critical parameters at the site are permeability, saturation of the cleat system, gas content, capillary pressure, and mechanical properties of the coal. Less critical, but also reviewed are adsorption isotherms, diffusion time, desorption critical pressure, and porosity.

0320 Transport, Pipelines, And Handling

45689 **(PB—86-203254/XAB) Reference standard polyethylene resins and piping materials. Annual report, October 1, 1984-September 30, 1985.** Crissman, J.M.; Wang, F.W.; Guttman, C.M.; Maurey, J.R.; Wagner, H.L. (National Bureau of Standards, Washington, DC (USA). Polymers Div.). Nov 1985. 19p. NTIS, PC A02/MF A01.

Polyethylene piping is currently in widespread use in gas distribution in the United States, and represents approximately 80% of new installation. Research that is currently being performed on gas pipes often employs many different polyethylenes selected from the large number of polyethylenes available for the use. The variation in materials makes it difficult to compare results from different research laboratories, or to compare measurements carried out in the same laboratory at different times. To avoid the difficulty, Gas Research Institute and the National Bureau of Standards (NBS) have undertaken to provide a permanent store of one particular polyethylene resin as well as piping and fittings made from it which would provide a source of well characterized materials for research related to gas-distribution systems. The report describes the choice of the resin and the types and quantities of the materials to be provided by NBS. Also described are some preliminary results on the characterization of the resin.

0330 Properties

45690 **(N—86-24962) Measurement of viscosity of gaseous mixtures at atmospheric pressure.** Singh, J.J.; Mall, G.H.; Chegini, H. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). May 1986. 19p. (NASA-TP—2582; L—16103). NTIS, PC A02/MF A01.

Coefficients of viscosity of various types of gas mixtures, including simulated natural-gas samples, have been measured at atmospheric pressure and room temperature using a modified capillary tube method. Pressure drops across the straight capillary tube section of a thermal mass flowmeter were measured for small, well-defined, volume flow rates for the test gases and for standard air. In this configuration, the flowmeter provides the volumetric flow rates as well as a well-characterized capillary section for differential pressure measurements across it. The coefficients of viscosity of the test gases were calculated using the reported value of 185.6 micro P for the viscosity of air. The coefficients of viscosity for the test mixtures were also calculated using Wilke's approximation of the Chapman-Enskog (C-E) theory. The experimental and calculated values for binary mixtures are in agreement within the reported accuracy of Wilke's approximation of the C-E theory. However, the agreement for multicomponent mixtures is less satisfactory, possible because of the limitations of Wilkes's approximation of the classical dilute-gas state model.

0340 Combustion

45691 **(PB—86-214012/XAB) Elementary processes in the catalytic combustion of methane (mechanism, intermediates, and controlling reactions). Final report, October 1981-December 1985.** Wise, H.; Quinlan, M. (SRI International, Menlo Park, CA (USA)). May 1986. 106p. NTIS, PC A06/MF A01.

Three transition metals (Ni, Ir, and Pt) were studied as catalysts for the oxidation of methane. These metals were chosen because of their different reactivities toward oxygen and hydrocarbons. The evaluation of their catalytic properties for methane oxidation was based on specific catalyst activity for complete oxidation, susceptibility to poisoning by sulfur compounds during catalytic reaction, quantitative reaction kinetics, formation of partially oxidized products, and effect of gaseous additives on methane oxidation. The experimental results demonstrated the superior performance of the noble-metal (NM) catalysts (Pt and Ir) over the base-metal (BM) catalyst (Ni). The NM catalysts combine high specific activity for oxidation of both methane and sulfur compounds, making them the most-suitable candidates for natural gas combustion without loss in activity caused by sulfur compounds used as odorants in the feed stream.

45692 **(PB—86-215662/XAB) Integrated natural-gas-engine cooling-jacket vapor-compressor program. Annual report (Phase 1A), February 1985-October 1985.** DiBella, F.A.; Balsavich, J.; Becker, F. (Thermo Electron Corp., Waltham, MA (USA)). Dec 1985. 165p. NTIS, PC A08/MF A01.

The project objective is to design and test a prototype Integrated Gas Engine Vapor Compression System; a system that is

thought to be an attractive and economically viable alternative to currently available cogeneration systems. A unique, alternative cogeneration system has been designed that will provide an industrial or commercial energy user with high-pressure steam and electricity directly from a packaged cogeneration system. The Integrated Gas Engine Vapor Compression System concept includes an engine-generator set and a steam screw compressor that is mechanically integrated with the engine.

0350 Storage

REFER ALSO TO CITATION(S) 45678

04 OIL SHALES AND TAR SANDS

0401 Reserves And Exploration

REFER ALSO TO CITATION(S) 45683

45693 **(DOE/LC/10916—1984) Reconnaissance examination of selected oil sand and oil spring occurrences in Wyoming. Final report.** Ver Ploeg, A.J. (Wyoming Geological Survey, Laramie (USA)). Jun 1986. Contract AS20-82LC10916. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86001096.

Numerous oil seeps and oil sands have been reported in the literature in Wyoming. Clark and Glass (Clark, M., and Glass, G.B., 1982, Review of reported tar sand occurrences and recent projects in Wyoming: Geological Survey of Wyoming Open File Report 82-5, 49 p.) reviewed the literature for reports of occurrences and catalogued 78 reported occurrences of shallow or outcropping oil sands and oil seeps in Wyoming. The majority of these references are quite old, with vague descriptions of locations and formations containing the oil. The purpose of this study was to do a reconnaissance field examination of selected occurrences to better describe the occurrence and make some assessment as to the potential economic importance of the deposit. A reconnaissance geologic map of the occurrence was constructed from field observations and existing maps from the literature. The deposit was sampled, described and photographed. Since it was impossible to visit 78 reported occurrences, the author visited only those surface occurrences which appeared significant based on the descriptions in the literature. A total of ten occurrences were visited and described during the summers of 1984 and 1985. The author attempted to locate additional reported occurrences, but either the description in the literature was too vague to locate the deposit or evidence of the occurrence could no longer be located due to developmental activity in the area. Also, a few of the occurrences which were located were deemed to be insignificant and were not described in detail or sampled. The oil sand occurrences examined were all in sandstones of varying depositional environments and ranged in age from Tertiary to Pennsylvanian. Examples of both structural and stratigraphic traps were examined. Both oil seeps examined appeared to be related to nearby faults. Some of the occurrences contain live oil at the outcrop while others appeared to contain primarily dead oil. 39 refs., 32 figs.

45804 **(PB—86-215720/XAB) Devonian-shale well-log interpretation. Annual report, 1985.** Truman, R.B.; Campbell, R.L. (ResTech Houston, Inc., TX (USA)). Feb 1986. 111p. NTIS, PC A06/MF A01.

Prototype geophysical well-log interpretation models were developed to determine the lithology, porosity, and bulk-volume free hydrocarbon in the Devonian shale. These models are based on quantitative thin section point count and x-ray-diffraction measurements made on mechanical sidewall core samples taken in the same Devonian-shale wells in which the geophysical well logs were recorded. The porosity determined using these lithology and porosity models compares favorably with the porosity measured on the core samples in the laboratory. Integration of the results from the quantitative geophysical well-log interpretation with the qualitative interpretation of the mud logs, temperature surveys, noise logs and borehole television has led to the development of a qualitative producibility model.

0403 Drilling, Fracturing, And Mining

45895 **(PB—86-204393/XAB) Large-bore viscometry tests on a shale slurry.** Grove, T.W. (British Hydromechanics Research Association, Cranfield). 1983. 16p. (RR—2011). NTIS, PC A03/MF A01.

The report covers work undertaken on behalf of the National Coal Board. Full-scale tests were carried out using a 4-inch-diameter tube viscometer to measure pipeline losses over a range of slurry throughputs. Bench-scale rotational viscometry tests were also performed to corroborate the full-scale test results.

0404 Oil Production, Recovery, And Refining

45696 **(DOE/LC/10036—2009-Vol.1) Occidental vertical modified in situ process for the recovery of oil from oil shale, Phase 2. Construction, operation, testing, and environmental impact. Final report, August 1981-December 1982. Volume 1.** Stevens, A.L.; Zahradnik, R.L.; Kaleel, R.J. (Occidental Oil Shale, Inc., Grand Junction, CO (USA); TRC Environmental Consultants, Inc., Englewood, CO (USA)). Jan 1984. Contract FC20-79LC10036. 516p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86006610.

Occidental Oil Shale, Inc. (OOSI) recently completed the demonstration of mining, rubblization, ignition, and simulataneous processing of two commericalized modified in situ (MIS) retorts at the Logas Wash facility near DeBeque, Colorado. Upon completion of Retort 6 in 1978, Occidential began incorporating all of the knowledge previously acquired in an effort to design two more commercial-sized MIS retorts. Any commercial venture of the future would require the ability to operate simultaneously more than one retort. Thus, Retorts 7 and 8 were developed during 1980 and 1981 through joint funding of the DOE and OOSI in Phase II. Rubblization of the retorts produced an average rubble void of 18.5% in the low grade shale (17 gallons per ton) at the Logan Wash site. After rubblization, bulkheads were constructed, inlet and offgas pipes were installed and connected to surface processing facilities and liquid product handling systems were connected to the retorts. Extensive instrumentation was installed in cooperation with Sandia National Laboratories for monitoring the complete operation of the retorts. After pre-ignition testing, Retort 8 was ignited in December of 1981 and Retort 7 was ignited in January of 1982. The retorts were operated without interruption from ignition until mid- November of 1982 at which time inlet gas injection was terminated and water quenching was begun. Total product yield from the two retorts was approximately 200,000 barrels of oil, or 70% of the Fischer Assay oil-in-place in the rubblized rock in the two retrots. Water quenching studies were conducted over a period of several months, with the objective of determining the rate of heat extraction from the retorts as well as determining the quantity and quality of offgas and water coming out from the quenching process. Data from these studies are also included in this Summary Report. 62 figs., 18 tabs.

45697 **(DOE/LC/10036—2009-Vol.2) Occidental vertical modified in situ process for the recovery of oil from oil shale, Phase 2. Tracer test results. Final report, August 1981-December 1982. Volume 2.** Wojdac, L.; Peterson, J. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Jan 1984. Contract FC20-79LC10036. 508p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE86006611.

The main objectives of the tracer test program were to: (1) Determine the overall gas flow distribution. (2) Define any areas of channeling. (3) Determine the active void. (4) Determine the gas flow distribution in Intermediate Levels of the Retort. During the retort 6 tracer tests and those performed on Mini-Retorts 3 and 4, it was found that when tracer was injected into the plenum, only very disperse tracer curves were detected. The dispersion was the result of extensive mixing in the plenum. As a result, tracer was injected below the rubble surface in all of the tracer tests for Retorts 7 and 8. Sulfur hexafluoride SF was used as a tracer in all tests. The air flow rate was maintained approximately constant at 16,000 SCFM during all tests. Each retort was tracer tested in three test sequences: (1) Upper Level to Intermediate Level; (2) Intermediate

Level to Lower Level; (3) Upper Level to Lower Level. In each sequence, tracer was injected into a single gas sampling tap while an array of taps were sampled at a lower level. The array was selected to obtain space time velocities and to measure the lateral flow through the retort. Wall taps were used to determine the degree of channeling that could be expected along the walls of the retorts.

45698 **(DOE/LC/10036—2009-Vol.3) Occidental vertical modified in situ process for the recovery of oil from oil shale, Phase 2. Air quality and meteorological data. Final report, August 1981-December 1982. Volume 3.** Stevens, A.L.; Zahradnik, R.L. (Occidental Oil Shale, Inc., Grand Junction, CO (USA)). Jan 1984. Contract FC20-79LC10036. 469p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE86006612.

Volume III contains monthly air monitoring reports for Logan Wash Oil Shale site from January 1982 through December 1982.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 45674, 45699

0409 Waste Research And Management

45699 **(DOE/FE/60177—2152) Extraction of inorganic chemical constituents from retorted oil shale by complexometric agents.** Essington, M.E.; Carroll, R.B. (Western Research Inst., Laramie, WY (USA)). Sep 1985. Contract FC21-83FE60177. 54p. (WRI—86-021M). NTIS, PC A04/MF A01; GPO Dep. File Number DE86014286.

Synthetic leachate solutions containing complexometric agents were used to simulate the long-term release of trace metals, carbonates, and sulfates from indirectly retorted (IH) and directly retorted (DH) oil shale. This approach was also taken to accelerate the leaching process in a lab scale/real time leach test which would approach the maximum potential release of chemical constituents. The complexometric agents examined were acetate, oxalate, and citrate ions, and EDTA and DTPA. Retorted oil shales were also extracted with distilled-deionized water. Leachate samples were analyzed for silver, arsenic, boron, barium, cadmium, chromium, copper, iron, mercury, molybdenum, nickel, lead, antimony, selenium, vanadium, zinc, fluorine, carbonate, and sulfate. For the indirectly retorted oil shale, maximum metallic element leachability was observed with EDTA and DTPA. In general, as the length of extraction period increased so did metal extractability. The DH sample, composed mineralogically of a number of high-temperature alteration products, produced higher leachate pH and electrical conductivity values. This was attributed to the instability of high-temperature mineral phases at low temperatures and pressures. Oxalate, in addition to EDTA and DTPA, was found to affect a high trace metal solubility. The extractability of trace metallic elements from DH, however, was lower than that for IH, thus illustrating the insolubility of metallic element-bearing minerals at high pH and the ability of ionic species released from DH to form sparingly soluble solids with trace metallic elements. 29 refs., 12 figs., 16 tabs.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 45696, 45698

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 46253

0501 Reserves

45700 **(IAEA-TECDOC—361) Vein type uranium deposits. Report of the Working Group on Uranium Geology.** (International Atomic Energy Agency, Vienna (Austria)). Jan 1986. 423p. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

Veins are tabular- or sheet-like masses of minerals occupying or following a fracture or a set of fractures in the enclosing rock. They have been formed later than the country rock and fractures, either by filling of the open spaces or by partial or complete replacement of the adjoining rock or most commonly by both of these processes combined. This volume begins with the occurrences and deposits known from old shield areas and the sedimentary belts surrounding them. They are followed by papers describing the European deposits mostly of Variscan age, and by similar deposits known from China being of Jurassic age. The volume is completed by two papers which do not fit exactly in the given scheme. A separate abstract was prepared for each of the 25 papers in this report.

45701 (IAEA-TECDOC—361, pp 9-20) **Problem of uranium mineralization in precambrian metamorphic shear tectonites - with particular reference to the Singhbhum copper-uranium belt, Eastern India.** Sarkar, S.C. (Department of Geological Sciences, Jadavpur Univ., Calcutta, India). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

Uranium mineralization has taken place discontinuously along the 200 km long Singhbhum Copper-Uranium Belt, Eastern India, concentration being more in the central part. The early Proterozoic rocks containing the mineralization are characterized by L-S type structures and zones of mylonitization. The principal orebody at Jaduguda extends for more than 1 km along the dip (40 deg. to 60 deg.). There is evidence on all scales that deformation has outlasted ore mineralization. The zones of intense copper and uranium mineralization do not coincide, although some uranium is recoverable from the tailings of the copper ores from most of the deposits mined. The average grade of the uranium ore from the Singhbhum Belt is $<0.01\%$ U_3O_8. The principal ore mineral, uraninite, occurs as disseminated grains and crystals. Other uranium-bearing minerals are sooty pitchblende, a complex U-Ti oxide, allanite, xenotime, davidite, pyrochlore-microlite, clarkeite, autunite, torbernite, schoepite and uranophane. Ni(-Co)-Mo-S(-As-Se)-mineralization occurs close to that of uranium in the Jaduguda-Bhatin sector. The dominance of uraninite over pitchblende, the presence of several percents of REE in uraninte, the development of hematite-bearing quartz and sodic oligoclase at places, the local association of uranium mineralization and Ni(-Co)-Mo-S(-As-Se)-mineralization and the continuation of some of the ore veins to considerable depth suggest these ores formed at moderately high temperatures. The age of mineralization is 1500 to 1600 Ma. 19 refs., 6 figs., 1 tab.

45702 (IAEA-TECDOC—361, pp 21-42) **Uranium genesis within the Arjeplog-Arvidsjaur-Sorsele uranium province, Northern Sweden.** Haalenius, U.; Smellie, J.A.T.; Wilson, M.R. (Sveriges Geologiska Undersoekning, Luleaa). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

The Arjeplog-Arvidsjaur-Sorsele uranium province in Northern Sweden represents a new crustal addition along the southern margin of the Svecokarelian Archaean 'Karelian Continent' with extensive granitoid formation at 1900-1850 Ma from igneous sources with a very short crustal history. Emplacement of the magmas has been strongly controlled by deep marginal faults. The more acid varieties of the igneous rocks can be uranium-enriched. Granite intrusion can be considered coeval with regional metamorphism and has probably provided the driving mechanism to cause hydrothermal fluid movement. During the passage of these fluids through the volcano-sedimentary and granitic country rocks, elements such as Ca, Na, U and Ti were mobilized, concentrated and transported. Movement of these hydrothermal solutions has been facilitated by pre-existing faults and more permeable lithological horizons. Eventually, under favourable physico-chemical conditions, the precipitation of certain elements and removal of others has resulted in the formation of alkali metasomatites and later uranium mineralization. 27 refs., 7 figs., 6 tabs.

45703 (IAEA-TECDOC—361, pp 43-55) **Vein-type uranium mineral occurrences in South Greenland.** Nyegaard, P.; Armour-Brown, A.; Steenfelt, A. (Groenlands Geologiske Undersoegelse, Copenhagen, Denmark). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

Many vein-type uranium mineral occurrences are located in South Greenland. These veins lie in what is termed the "Granite Zone" within the Proterozoic Ketilidian mobile belt (1900-1600 Ma). In this area the crystalline rocks were subjected to a period of faulting accompanied by the cratonic depositional and alkaline igneous activity of the Gardar period (1150-1350 Ma). The faulting is intensive and in many different directions, but is interpreted as being caused by a regional, EW orientated, sinistral stress system. The pitchblende veins and the many minor radioactive mineral occurrences are located in or associated with fault zones. U-Pb isotope analyses of the pitchblende indicate a Gardar age of 1180 +- 15 Ma. In the most extensive occurrences pitchblende and secondary uranium minerals are the most common radioactive minerals. In many of the minor occurrences brannerite is found. The gangue minerals are mainly quartz and calcite with varying amounts of specular hematite, fluorite and minor sulphides. Reconnaissance exploration results revealed that there are also uranium mineral occurrences in the Ketilidian rocks to the south of the Granite Zone. The genesis of the uraniferous veins is believed to have been controlled by the Gardar faulting, which facilitated the hydrothermal circulation of the volatiles derived from the Gardar igneous activity. The uranium itself is believed to have been derived to some extent from the highly differentiated alkaline units, but probably mostly from the older Ketilidian occurrences. 29 refs., 2 figs., 1 tab.

45704 (IAEA-TECDOC—361, pp 57-76) **Geological environment of the vein-type deposits in the Aphebian basement of the Carswell structure on the Athabasca plateau (Northern Saskatchewan). Comparison with other deposits of the same type.** Artru, P.; Berville, M.; Moreau, M.; Tona, F. (Compagnie Generale des Matieres Nucleaires, COGEMA, 78 - Velizy, Villacoublay, France). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

Cluff Lake basement deposits are characterized by their stratigraphic position in or close to a dominantly aluminous, graphitic and pyritic metasedimentary formation (Peter River gneiss), most probably a former black shale. They are also close to an underlying unit consisting of quartzo-feldspathic gneisses (Earl River Complex) which could be a former arkosic sandstone, metamorphosed and reactivated. This latter unit is mainly found in the heart of dome shaped anticlines (mantled gneiss domes). The reactivation process created favourable conditions for mobilization of uranium into small concentrations early (1800 Ma) in the metamorphics. The main structural control of the deposits appears to be Hudsonian mylonites and subsequent fracturation. However, it is after the deposition of the Athabasca Sandstone that the mylonites and their associated fractures were rejuvenated and invaded by hydrothermal fluids. A widespread alteration pervaded through the surrounding rocks and uranium precipitated in the open fractures. Several phases with different praragenesis can be identified with ages spreading from 1200 Ma to 900 Ma although some remobilization occurred much later. The 480 Ma violent tectonic event associated with the formation of the Carswell structure and the injection of the Cluff Breccia further complicated the structure, partially obscuring the earlier events. The unconformity deposits are represented in Cluff Lake by the well known D deposit. An important Hudsonian mylonite is the main link between this deposit and the Peter River basement deposit. The ages of both mineralizations are similar, leading to the conclusion that both result from the same long mineralizing process. Adaptation of this process to different lithological environments gave birth to two very different types of deposits. 52 refs., 7 figs.

45705 (IAEA-TECDOC—361, pp 77-84) **Pandanus Creek Uranium Mine, Northern Territory, Australia.** Morgan, B.D.; Campi, D. (Triad Minerals N.L., Melbourne, Australia; Metals Exploration Ltd., Melbourne, Australia). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

The Pandanus Creek Uranium Mine was discovered in 1958 and selectively mined between 1960 and 1962 for a yield of 26 t U_3O_8. The mine is situated on a tectonic ridge of Lower Proterozoic metamorphics intruded by a granite complex with comagmatic acid volcanics of basal Middle Proterozoic age (1770 Ma). The volcanics are the mine host rocks. The primary ore consists of lenses of pitchblende along shears developed within a meta-quartzite adjacent to a granite intrusion. The pitchblende has suffered extensive supergene alteration due to tropical weathering since Mesozoic times. The core contains significant gold and silver. The pitchblende was emplaced 850 Ma ago, after widespread faulting of overlying Middle Proterozoic rocks. The source of the uranium is believed to be the basement rocks of the tectonic ridge. Hydrothermal solutions ascended along the major faults and deposited pitchblende preferentially in adjacent minor structures within the volcanics. 12 refs., 3 figs.

45706 (IAEA-TECDOC—361, pp 85-100) **Structure related uranium mineralization in the Westmoreland District, Queensland, Australia.** Schindlmayr, W.E.; Beerbaum, B. (Urangesellschaft Australia Pty. Ltd., Melbourne). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

The Westmoreland Uranium District straddles the boundary between Queensland and the Northern Territory of Australia some 100 km south of the coastline. Middle Proterozoic conglomerate/sandstones and a basic volcanic sequence of the McArthur River Basin unconformably overly Lower Proterozoic metamorphics and acid volcanics, both intruded by high level granites, which are exposed in an EW trending uplift. Basic dikes, thought to be feeders to the multiple basic extrusions were emplaced mainly along the NE trending structures dissecting the sandstone sequence. Uranium mineralization in the district frequently occurs as vertical or subvertical, discontinuous lenses or sheets adjacent to or within these dike filled structures. The primary minerals are uraninite and protobrannerite. Gold may occur coincidental to uranium. Uraninite is the last replacive mineral phase, following cementation and argillic alteration of the host rocks and the introduction of chlorite/hematite. The primary origin of the uranium remains open due to lack of conclusive evidence for introduction of the uranium into the system either as detrital component or by exhalative volcanogenic activity or by hydrothermal remobilization from deep seated sources. It is postulated that a heat flow event at about 820 Ma generated and maintained convection flow cells within permeable host rocks and that uranium introduced to circulating oxygenated formation waters by any one or more of the above processes was precipitated against physico-chemical barriers such as basic dikes or basaltic flows due to the abundant supply of divalid iron as reductant. 17 refs., 5 figs., 1 tab.

45707 (IAEA-TECDOC—361, pp 101-112) **Mt. Painter uranium deposits.** Youles, I.P. (Oilmin N.L., Adelaide, Australia). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

The Mt. Gee, Armchair, Streitberg Ridge and Radium Ridge primary uranium deposits consist of uraninite, pyrite, chalcopyrite, molybdenite, monazite, fluorite and barite in a matrix of chlorite and hematite, which infilled and replaced, as layers, a potash rich (10% K_2O), partly sericitized, granitic breccia in the Radium Ridge Beds (interpreted about 700 Ma). Minor amounts of sandstone, siltstone, diamictite and arkose also occur. Uranium content averages 0.1% along with Cu 0.05%, Mo 0.03%, Co 0.035% and Ce group 0.5%. Isotopic data indicate a magmatic origin and fluid inclusions show temperatures of 300 deg. C - 400 deg. C with

aqueous solutions of low salinity. The Hodgekinson deposit consists of uraninite with silica, pyrite, minor arsenopyrite and trace sulphides in brecciated, foliated, granitic rocks, which were silicified or kaolinized and sericitized; repetitive brecciation with infillings of uraninite, pyrite and chalcedony occurred, the latest being a secondary enrichment through downward leaching. Early mine workings are in permeable zones, usually faults, in or adjacent to primary deposits; torbernite and autunite were deposited in voids by groundwaters of probable Tertiary age. 13 refs., 5 figs., 4 tabs.

45708 (IAEA-TECDOC—361, pp 113-142) **Petrographic-geochemical characteristics and genesis of an albitized uraniferous granite in Northern Cameroon, Africa.** Oesterlen, M.; Vetter, U. (Urangesellschaft m.b.H. und Co. K.G., Frankfurt am Main, Germany, F.R.; Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover, Germany, F.R.). Jan 1986. NTIS (US Sales Only), PC A18/MF A01. File Number DE86703159.

In Vein type uranium deposits. Report of the Working Group on Uranium Geology.

A petrographic and geochemical investigation of an albite-uraninite paragenesis associated with the Panafrican Kitongo granite was made. Several distinct mineralization phases were identified. Partial melting of a granodioritic source rock produced a restite-bearing I-type monzogranite in the magmatic stage. The granite ascended synorogenically in tectonic structures and intruded volcano-sedimentary rocks of upper amphibolite facies, which occur in the granite as xenoliths. Residual late-magmatic melts enriched in K or Na were formed locally. In the post-magmatic stage, the granite was first affected by two phases of pneumatolytic to hydrothermal metasomatism: a first albitization led to the replacement of plagioclase by albite, the alteration of hornblende to Na-Ca amphibole, and the formation of a Zr-Ce-La mineralization. In the second albitization phase, the potassium feldspar component of the alkali feldspar and the quartz was replaced by albite, proceeding in steps until replacement was complete. Additional Zr, Ce, and La were introduced again, but remobilization of these elements also occurred. Riebeckite and aegirine were formed and partly altered. The hydrothermal phase of uraninite mineralization followed and then two late-hydrothermal phases: a quartz-epidote-carbonate paragenesis and an economically insignificant sulfide mineralization. The post-magmatic events are restricted to a region of jointed and sheared granite along the Kitongo fault zone. A comparison with other albite-uranium occurrences shows that in contrast to the Kitongo occurrence, which is in an I-type granite, most of the deposits of this type are in S- and A-type granites. This explains differences between the Kitongo occurrence and the others, e.g. different uranium phases and a lack of enrichment of Sn, W, F, Li, Nb, Ta, and Y. 36 refs., 24 figs., 2 tabs.

0503 Mining

REFER ALSO TO CITATION(S) 45705

0504 Feed Processing

REFER ALSO TO CITATION(S) 46241

0505 Enrichment

REFER ALSO TO CITATION(S) 45736

0507 Fuels Production And Properties

45709 (ORNL/TM—8999) **Accelerator breeder nuclear fuel production: concept evaluation of a modified design for ORNL's proposed TME-ENFP.** Johnson, J.O.; Gabriel, T.A.; Bartine, D.E. (Oak Ridge National Lab., TN (USA). Engineering Physics and Mathematics Div.). Jan 1985. Contract AC05-84OR21400. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86013420.

Recent advances in accelerator beam technology have made it possible to improve the target/blanket design of the Ternary Metal Fueled Electronuclear Fuel Producer (TMF-ENFP), an accelerator-breeder design concept proposed by Burnss et al. for subcritical breeding of the fissile isotope ^{233}U. In the original TMF-ENFP the 300-mA, 1100-MeV proton beam was limited to a small diameter whose power density was so high that a solid metal target could not be used for producing the spallation neutrons needed to drive the breeding process. Instead the target was a central column of circulating liquid sodium, which was surrounded by an inner multiplying region of ternary fuel rods (^{239}Pu, ^{233}Th, and ^{238}U) and an outer blanket region of ^{232}Th rods, with the entire system cooled by circulating sodium. In the modified design proposed here, the proton beam is sufficiently spread out to allow the ternary fuel to reside directly in the beam and to be preceded by a thin (nonstructural) V-Ti steel firThe spread beam mandated a change in the design configuration (from a cylindrical shape to an Erlenmeyer flask shape), which, in turn, required that the fuel rods (and blanket rods) be replaced by fuel pebbles. The fuel residence time in both systems was assumed to be 90 full power days. A series of parameter optimization calculations for the modified TMF-ENFP led to a semioptimized system in which the initial ^{239}Pu inventory of the ternary fuel was 6% and the fuel pebble diameter was 0.5 cm. With this system the ^{233}Pu production rate of 5.8 kg/day reported for the original TMF-ENFP was increased to 9.3 kg/day, and the thermal power production at beginning of cycle was increased from 3300 MW(t) to 5240 MW(t). 31 refs., 32 figs., 6 tabs.

0508 Spent Fuels Reprocessing

45710 (UJV—7295-CH,T) **Remote handling equipment for laboratory research of fuel reprocessing in Nuclear Research Institute at Rez.** Fidler, J.; Novy, P.; Kyrs, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Apr 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703154.

Laboratory installations were developed for two nuclear fuel reprocessing methods, viz., the solvent extraction process and the fluoride volatility process. The apparatus for solvent extraction reprocessing consists of a pneumatically driven rod-chopper, a dissolver, mixer-settler extractors, an automatic fire extinguishing device and other components and it was tested using irradiated uranium. The technological line for the fluoride volatility process consists of a fluorimeter, condensers, sorption columns with NaF pellets and a distillation column for the separation of volatile fluorides from UF_6. The line has not yet been tested using irradiated fuel. Some features of the remote handling equipment of both installations are briefly described.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 46346

45711 (EGG-M-T—0286) **Transporting fuel debris from TMI-2 to INEL.** Quinn, G.J.; Burton, H.M.; Bixby, W.W.; McIntosh, T.W.; McGoff, O.J.; Barkonic, R.J.; Henrie, J.O. (EG and G, Inc., Middletown, PA (USA); UNC Nuclear Industries, Inc., Richland, WA (USA). Decommissioning Programs Dept.; USDOE Technical Integration Office, Middletown, PA; USDOE, Washington, DC; Bechtel North American Power, Middletown, PA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jun 1986. Contract AC07-76ID01570. 8p. (CONF-860604—28; IAEA-SM—286-237-P). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013459.

From International symposium on the packaging and transport of radioactive materials (PATRAM '86); Davos, Switzerland (16 Jun 1986).

Transportation of the damaged fuel from Unit 2 of Three Mile Island (TMI-2) presented noteworthy technical challenges involving complex institutional issues. The program resulted from both a need to package and remove the accident debris and also the opportunity to receive and study damaged core components. These combined to establish the safe transport of the TMI-2 fuel debris as a high priority for many diverse organizations. The capability of the sending and receiving facilities to handle spent fuel transport

casks in the most cost-effective manner was assessed and resulted in the development by Nuclear Packaging Inc. (NuPac) of the NuPac 125-B rail cask. This paper reviews the technical challenges in preparation of the TMI-2 core debris for transport from TMI-2 to the Idaho National Engineering Laboratory (INEL) and receipt and storage of that material at INEL. Challenges discussed include design and testing of fuel debris canisters; design, fabrication and licensing of a new rail cask for spent fuel transport; cask loading operations, equipment and facilities at TMI-2; transportation logistics; and, receipt, storage and core examination operations at INEL. 10 refs.

45712 **(HE-TP—27930) Probability of traffic accidents associated with the transport of radioactive wastes.** James, I.A. (Hunting Engineering Ltd., Bedford (UK)). Jan 1986. 55p. (HE—2004/DN/010). NTIS (US Sales Only), PC A04/MF A01. File Number DE86703167.

This report evaluates the probability of a container impact during transit between generating and disposal sites. Probabilities per route mile are combined with the characteristics of the transport systems described in previous reports, to allow a comparison of different disposal options to be made.

45713 **(INIS-GB—8) Barnwood review.** (Central Electricity Generating Board, Barnwood (UK). Generation Development and Construction Div.). Sep 1985. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703168.

This review describes the work of the Generation Development and Construction Division of the [U.K.] Central Electricity Generating Board. It includes work on nuclear power plants and fossil-fuel power plants. The following activities concerned with nuclear power are described: brief summary of all nuclear power work; Dungeness B; Hartlepool/Heysham 1; Heysham 2; irradiated fuel project (engineering service in support of irradiated fuel transport operation; model validation; analysis; instrumentation; impact evaluation; transportation study; full scale crash demonstration; concluding comments); remote visual inspection service.

45714 **(UCRL—93645) New approach for calibration and interpretation of IRAD GAGE vibrating-wire stressmeters.** Mao, N. (Lawrence Livermore National Lab., CA (USA)). May 1986. Contract W-7405-ENG-48. 11p. (CONF-860985—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010975.

From International symposium on rock stress and rock stress measurements; Stockholm, Sweden (1 Sep 1986).

IRAD GAGE vibrating-wire stressmeters were installed in the Spent Fuel Facility at the Nevada Test Site to measure the change in in-situ stress during the Spent Fuel Test-Climax (SFT-C). This paper discusses the results of removing a cylindrical section of rock and gages as a unit through overcoring, and the subsequent post-test calibration of the stressmeters in the laboratory. The estimated in-situ stresses based on post test calibration data are quite consistent with those directly measured in nearby holes. The magnitude of stress change calculated from pre-test calibration data is generally much smaller than that estimated from post test calibration data. 11 refs., 5 figs., 2 tabs.

0520 Waste Management

REFER ALSO TO CITATION(S) 45714, 45733, 46123, 46174, 46671, 46762, 46765

45715 (BMI/OCRD—24, pp 19-39) **Licensing information needs for a high-level waste repository.** Wright, R.J.; Greeves, J.T.; Logsdon, M.J. (Nuclear Regulatory Commission, Washington, DC). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

The information needs for licensing findings during the development of a repository for high-level waste (HLW) are described. In particular, attention is given to the information and needs to demonstrate, for construction authorization purposes: repository constructibility, waste retrievability, waste containment, and waste isolation.

45716 (BMI/OCRD—24, pp 41-45) **Performance assessment.** Doe, T. (Office of Crystalline Repository Development, Columbus, OH). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

The purpose of performance assessment is to show that the repository is expected to serve its stated function - disposing of radioactive waste safely both during operation and for the postclosure period. Performance assessment is a straightforward concept, but its application may be very complicated. The concept of performance assessment has been clarified by the Nuclear Regulatory Commission (NRC) in their Draft Generic Technical Position on Licensing Assessment Methodology for High-Level Waste Geologic Repositories (NRC, 1984). This document has gone a long way toward defining the criteria that the NRC will use to determine whether or not information from site characterization is adequate to meet the regulations of the Nuclear Regulatory Commission and the Environmental Protection Agency (EPA). A favorable determination is required for issuance of a construction authorization, which is the first major regulatory requirement for developing a working repository. It is, therefore, essential that a research program be developed that not only resolves the outstanding technical issues, but also does it in such a way that the results are clearly applicable to the formal performance assessment and licensing procedures. The definitions of performance assessment are reviewed and the current NRC thinking is summarized.

45717 (BMI/OCRD—24, pp 47-100) **Construction, emplacement, and retrievability (preclosure).** McClain, W. (Roy F. Weston, Inc., Germantown, MD). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

Each of the three preclosure subgroups of the Construction, Emplacement, and Retrievability Working Group adopted a six-step approach to identify and assess current needs in geotechnical modeling and characterization. This approach may be summarized as follows: identify phenomena related to emplacement of high-level nuclear wastes, identify types of models which are required to calculate the phenomena, establish the input data needs for the models, assess the current availability of the models, assess the current status of documentation, verification, and validation of the models, and determine the adequacy of instrumentation and measurement techniques to (a) validate the models, where necessary, and (b) obtain input data for design. Systematic application of these six steps leads to the establishment of the research requirements for geotechnical modeling and characterization. A summary of modeling techniques which apply to the three subsequent sections on construction, emplacement, and retrievability is presented. Research needs, which apply to all preclosure activities, are summarized.

45718 (BMI/OCRD—24, pp 101-128) **Regional groundwater system.** Long, J. (Lawrence Berkeley Lab., CA). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

The Containment and Isolation Working Group considered issues related to the postclosure behavior of repositories in crystalline rock. This working group was further divided into subgroups to consider the progress since the 1978 GAIN Symposium and identify research needs in the individual areas of regional groundwater flow, ground-water travel time, fractional release, and cumulative release. The analysis and findings of the Ground-Water Regime Subgroup are presented.

45719 (BMI/OCRD—24, pp 129-141) **Ground-water travel time.** Bentley, H.; Grisak, G. (Hydro Geo Chem, Tucson, AZ). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

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45720 (BMI/OCRD—24, pp 143-157) **Fractional release from the engineered barrier system.** Oversby, V.; Sagar, B. (Lawrence Livermore National Lab., CA). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

The Containment and Isolation Working Group considered issues related to the postclosure behavior of repositories in crystalline rock. This working group was further divided into subgroups to consider the progress since the 1978 GAIN Symposium and identify research needs in the individual areas of regional groundwater flow, ground-water travel time, fractional release, and cumulative release. The analysis and findings of the Fractional Release Subgroup are presented.

45721 (BMI/OCRD—24, pp 159-172) **Cumulative release to the accessible environment.** Kanehiro, B. (Hydrotechnique Associates, Berkeley, CA). Sep 1985. NTIS, PC A09/MF A01. File Number DE86001933. (CONF-8410296—).

From Geotechnical assessment and instrumentation needs for isolation of nuclear waste in crystalline rocks; Berkeley, CA, USA (15 Oct 1984).

The Containment and Isolation Working Group considered issues related to the postclosure behavior of repositories in crystalline rock. This working group was further divided into subgroups to consider the progress since the 1978 GAIN Symposium and identify research needs in the individual areas of regional groundwater flow, ground-water travel time, fractional release, and cumulative release. The analysis and findings of the Fractional Release Subgroup are presented.

45722 (CONF-8609117—1) **Subsurface disposal of liquid low-level radioactive wastes at Oak Ridge, Tennessee.** Stow, S.H.; Haase, C.S. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013396.

From 19. congress of the International Association of Hydrogeologists; Karlovy Vary, Czechoslovakia (8 Sep 1986).

At Oak Ridge National Laboratory (ORNL) subsurface injection has been used to dispose of low-level liquid nuclear waste for the last two decades. The process consists of mixing liquid waste with cement and other additives to form a slurry that is injected under pressure through a cased well into a low-permeability shale at a depth of 300 m (1000 ft). The slurry spreads from the injection well along bedding plane fractures and forms solid grout sheets of up to 200 m (660 ft) in radius. Using this process, ORNL has disposed of over 1.5×10^6 Ci of activity; the principal nuclides are ^{90}Sr and ^{137}Cs. In 1982, a new injection facility was put into operation. Each injection, which lasts some two days, results in the emplacement of approximately 750,000 l (180,000 gal) of slurry. Disposal cost per liter is approximately $0.30, including capital costs of the facility. This subsurface disposal process is fundamentally different from other operations. Wastes are injected into a low-permeability aquitard, and the process is designed to isolate nuclides, preventing dispersion in groundwaters. The porosity into which wastes are injected is created by hydraulically fracturing the host formation along bedding planes. The site is in the structurally complex Valley and Ridge Province. The stratigraphy consists of lower Paleozoic rocks. Investigations are under way to determine the long-term hydrologic isolation of the injection zone and the geochemical impact of saline groundwater on nuclide mobility. Injections are monitored by gamma-ray logging of cased observation wells to determine grout sheet orientation after an injection. Recent monitoring work has involved the use of tiltmeters, surface uplift surveys, and seismic arrays. 26 refs., 7 figs.

45723 (DP—1722) **Radioactive waste spill and cleanup on storage tank at the Savannah River Plant.** Boore, W.G.; McNatt, F.G.; Ryland, R.K.; Scaggs, R.A.; Strother, E.D.; Wilson, R.W. (SEE CODE- 9520932 Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1986. Contract AC09-76SR00001. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014331.

This report was prepared for historical purpose to document events associated with a radioactive spill and subsequent cleanup efforts at the Savannah River Plant. On December 29, 1983, approximately 100 gallons of liquid radioactive waste, containing an estimated 200-600 curies of cesium-137, leaked from a flushwater line onto the top of the Savannah River Plant's Tank 13 in H-area. The highest measured radiation rate was 100 R/hr at 12 inches from the evaporator feed pump riser. The leak was caused by a series of events involving inadequate heat tracing on a flushwater line, failure of a gasket in 7°F weather, failure of personnel to follow a procedure, and leakage across a gate valve seat. Some of the leaked solution migrated into storm water ditches during rain, and a total of 237 millicuries migrated to a nearby stream over several months. However, no significant increase in the cesium-137 concentration occurred in the Savannah River or in the groundwater under the impacted area. Cleanup, costing 3.7 million dollars, took place over the following eighteen months. Cleanup involved water flushing, chemical flushing and mechanical removal of a portion of the concrete tank-top surface, followed by excavation of 1383 cubic yards of soil surrounding the tank. Stringent and effective radiological controls, including development of remote decontamination methods, allowed the cleanup to be accomplished with a total radiation dose to personnel of 58 rems. New safeguards were built into the system to protect against spills and to provide greater assurance of spill containment. Lead sheeting and a 4- to 6-inch-thick concrete overpour were bonded over the remaining contaminated concrete to reduce the radiation levels to less than 20 mR/hr at 3 feet. The Tank 13 evaporator feed system resumed operation in June 1985. 3 refs., 42 figs., 2 tabs.

45724 (DPST—84-537) **F and H Area Effluent Treatment Facility (F/H ETF): ultrafiltration and hyperfiltration systems testing at Carre, Inc. with simulated F and H area effluents.** Ryan, J.P. (SEE CODE- 9520932 Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 23 May 1984. Contract AC09-76SR00001. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86011832.

The F and H Area Effluent Treatment Facility is essentially a four-stage process that will decontaminate the waste water that is currently being discharged to seepage basins in the Separations Areas. The stages include pretreatment, reverse osmosis, ion exchange, and evaporation. A series of tests were performed at Carre, Inc. (Seneca, SC) from March 5 through March 13, to determine the usefulness of ultrafiltration (UF) in the pretreatment stage of the ETF. The results of that testing program indicate that UF would be an excellent means of removing entrained activity from the 200 Area process effluents. Hyperfiltration (HF) was also tested as a means of providing an improved concentration factor from the reverse osmosis stage. The results show that the membranes that were tested would not reject salt well enough at high salt concentrations to be useful in the final reverse osmosis stage. However, there are several membranes which are commercially available that would provide the needed rejection if they could be applied (dynamically) on the Carre support structure. This avenue is still being explored, as theoretically, it could eliminate the need for the F/H ETF evaporator.

45725 **(ORNL/TM—10002) Characterization of the homogeneous reactor experiment No. 2 (HRE) impoundment.** Stansfield, R.G.; Francis, C.W. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014420.

A characterization study was conducted on a radioactive waste impoundment for the Homogeneous Reactor Experiment No. 2 at the Oak Ridge National Laboratory, to provide information necessary for its proper disposition. The impoundment received low-level radioactive wastes from 1957 until 1963. In 1970, the pond was backfilled with clay soil and the impoundment capped with asphaltic concrete, but no wastes were removed. The mixed soil fill and sediment, approximately 4.8 m deep, was sampled using soil boring methods. The samples were analyzed to determine if the material would classify as a hazardous waste under regulatory definitions promulgated in accordance with the Resource Conservation and Recovery Act (RCRA). If the soil and sediment mixture contained RCRA-defined hazardous waste, it would be subject to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Chemical analyses indicate that the sampled material does not contain hazardous chemical constituents above the levels permitted by RCRA regulations. The sediment was found to contain an estimated radioactivity inventory of approximately 2700 GBq (70 Ci) of ^{90}Sr and 600 GBq (16 Ci) of ^{137}Cs.

45726 **(PB—86-210531/XAB) Radiological measurement at the Maxey Flats radioactive waste burial site - 1974 to 1975.** Montgomery, D.M.; Kolde, H.E.; Blanchard, R.L. (Office of Radiation Programs, Washington, DC (USA)). Jan 1977. 109p. (EPA/520/5—76/020). NTIS, PC A06/MF A01.

The report discusses radiological measurements made by the Radiochemistry and Nuclear Engineering Branch, Cincinnati, at the request of the ORP Technology Assessment Division in support of EPA's program to obtain data on the principles and processes of land burial and the actual impact on the environment of presently operating commercial burial facilities. The information obtained indicates that the quantities of radioactivity detected outside the burial trenches are so low that they do not appear to be a significant hazard to the environment or to public health in the Maxey Flats area, at the present time. However, the potential long-range impact of these contaminants is not known.

45727 **(PNL—5830) Composition of high fission product wastes resulting from future reprocessing of commercial nuclear fuels.** Swanson, J.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014820.

Pacific Northwest Laboratory studies, aimed at defining appropriate glass compositions for future disposal of high-level wastes, have developed composition ranges for the waste that will likely result during reprocessing of Light Water Reactor (LWR) and Liquid Metal Reactor (LMR) fuels. The purpose of these studies was to provide baseline waste characterizations for possible future commercial high-level waste so that waste immobilization technologies (e.g., vitrification) can be studied. Ranges in waste composition are emphasized because the waste will vary with time as different fuels are reprocesses, because choice of process chemicals is nuclear, and because fuel burnups will vary. Consequently, composition ranges are based on trends in fuel reprocessing procedures and on achievable burnups in operating reactors. In addition to the fission product and actinide elements, which are the primary hazardous materials in the waste, likely composition ranges are given for inert elements that may be present in the waste. These other elements may be present because of being present in the fuel, because of being added as process chemical during reprocessing, because of being added during equipment decontamination, or because of corrosion of plant equipment and/or fuel element cladding. This report includes a discussion of the chemicals added in variation of the PUREX process, which is likely to remain the favored reprocessing technique for commercial nuclear fuels. Consideration is also given to a pyrochemical process proposed for the reprocessing of some LMR fuels.

45728 **(PNL—5919) Demonstration of an approach to waste form qualification through simulation of liquid-fed ceramic melter process operations.** Reimus, P.W.; Kuhn, W.L.; Peters, R.D.; Pulsipher, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 103p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86014819.

During fiscal year 1982, the US Department of Energy (DOE) assigned responsibility for managing civilian nuclear waste treatment programs in the United States to the Nuclear Waste Treatment Program (NWTP) at the Pacific Northwest Laboratory (PNL). One of the principal objectives of this program is to establish relationships between vitrification process control and glass quality. Users of the liquid-fed ceramic melter (LFCM) process will need such relationships in order to establish acceptance of vitrified high-level nuclear waste at a licensed federal repository without resorting to destructive examination of the canisters. The objective is to be able to supply a regulatory agency with an estimate of the composition, durability, and integrity of the glass in each waste glass canister produced from an LFCM process simply by examining the process data collected during the operation of the LFCM. The work described here will continue through FY-1987 and culminate in a final report on the ability to control and monitor an LFCM process through sampling and process control charting of the LFCM feed system.

45729 **Nuclear Waste Policy Act of 1982: progress and problems. Hearings before the Subcommittee on Energy Research and Production of the Committee on Science and Technology, House of Representatives, Ninety-Ninth Congress, First Session, November 6, 7, 1985.** Washington, DC; Government Printing Office (1986). 672p.

Representatives of the nuclear industry, nuclear waste programs, local governments, and state and federal waste agencies testified at a two-day hearing on the status of the Nuclear Waste Policy Act (NWPA) of 1982 implementation. Witnesses were asked to explore five major issues: scheduling problems, the validity of complaints about cooperative aspects, the political impact of the Monitored Retrievable Storage (MRS) facility, the adequacy of the plan, and the need for legislative revisions. Witnesses spoke of public concerns about the transport of radioactive wastes and the technological problems of storage. A report from the Oak Ridge, Tennessee, MRS Task Force evaluated DOE's MRS facility proposal for the area and concluded that a safe facility is possible if its regulatory and economic recommendations are followed. Two appendices with additional materials and responses submitted for the record follow the testimony of the 11 witnesses.

45730 **Disposal of high-level nuclear waste. Hearing before the Committee on Environment and Public Works, United States Senate, Ninety-Ninth Congress, First Session, October 30, 1985.** Washington, DC; Government Printing Office (1986). 435p.

Representatives of the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency, state public service commissions and waste offices, and the general public testified at a hearing on the siting of siting waste disposal facilities. At issue was the possibility of placing such a site in Vermont because of its geographic location, its extreme winter climate, and its unsuitable geology. Concerns at public hearings in Vermont and elsewhere emphasized the need to review the current Nuclear Waste Policy Act to see that legislative intent has been followed and whether its focus on political rather than technological solutions is sound. Speakers focused on health and environmental issues in the siting question. NRC Chairman Palladino described how the DOE has performed its mission plan under the program. Material submitted for the record follows the testimony of 15 witnesses.

45731 **Analytical methods and laboratory facility for the Defense Waste Processing Facility.** Coleman, C.J.; Dewberry, R.A.; Letcho, A.J.; Denard, C.D. (Savannah River Lab., Aiken, SC). pp 337-343 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC09-76SR00001.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

This paper describes the analytical methods, instruments, and laboratory that will support vitrification of defense waste. The Defense Waste Processing Facility (DWPF) is now being constructed at Savannah River Plant (SRP). Beginning in 1989, SRP high-level defense waste will be immobilized in borosilicate glass for disposal in a federal repository. The DWPF will contain an analytical laboratory for performing process control analyses. Additional analyses will be performed for process history and process diagnostics. The DWPF analytical facility will consist of a large shielded sampling cell, three shielded analytical cells, a laboratory for instrumental analysis and chemical separations, and a counting room. Special instrumentation is being designed for use in the analytical cells, including microwave drying/dissolution apparatus, and remote pipetting devices. The instrumentation laboratory will contain inductively coupled plasma, atomic absorption, Moessbauer spectrometers, a carbon analyzer, and ion chromatography equipment. Counting equipment will include intrinsic germanium detectors, scintillation counters, Phoswich alpha, beta, gamma detectors, and a low-energy photon detector.

45732 **Electrical service and controls for joule heating of a nuclear waste experimental glass melter.** Erickson, C.J.; Haideri, A.Q. (E.I. du Pont de Nemours & Co., Wilmington, DE). pp 1-6 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—).

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

Safe storage of highly radioactive waste is a problem facing the nuclear industry. The best technique developed to date, for long-term storage, is to encapsulate the waste into borosilicate glass. Ceramic lined electric glass melters have been demonstrated as systems for nuclear waste vitrification. The Department of Energy recently authorized the installation of an experimental glass melter at the Savannah River nuclear facility. Nonradioactive slurry, with the same chemical/physical properties as existing radioactive waste slurry was mixed with glass frit, melted, poured into containers, and allowed to solidify. Initially, the slurry was calcined (dried) before mixing with the frit and being dropped into the melter. Later, the drying step was eliminated; the liquid slurry and glass frit are fed directly into the melter. Vaporizing the water adds to the heating requirements in the melter. The glass is poured into cannisters by either tilting the melter or drawing a vacuum at the pour spout. This melter concept is a prototype for a melter to be installed in a "canyon" building. The "canyon" is an isolated building with provision for radioactive confinement. No personnel can be in the building, so all operations and maintenance are remotely performed. Remote operation is made possible by comprehensive instrumentation and closed-circuit television viewing.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 45725, 46759

0540 Health And Safety

REFER ALSO TO CITATION(S) 45723

45733 **(NUREG/CR—3585-Vol.2) De Minimis waste impacts analysis methodology. IMPACTS - BRC user's guide and methodology for radioactive wastes below regulatory concern. Draft report for comment. Volume 2.** Forstom, J.M.; Goode, D.J. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management). Jul 1986. 152p. NTIS, PC A08/MF A01 - GPO. File Number TI86901613.

This report describes the methodology and computer program used by NRC to evaluate radiological impacts associated with petitions to have specific slightly contaminated radioactive waste streams designated as "below regulatory concern." These wastes could be treated and disposed of at facilities which are not licensed for low-level radioactive waste management. The IMPACTS-BRC computer program is implemented on IBM-PC microcomputers using the FORTRAN programming language. Radiological impacts (doses) are estimated for several pathways including direct gamma radiation exposure, worker inhalation and exposure, offsite atmospheric and water releases, and intruder exposures. Annual impacts are calculated for the maximum individual, critical groups, and general population. The treatment and disposal options include onsite incineration, incineration at municipal and hazardous waste facilities, and disposal at sanitary landfills and hazardous waste landfills. Modifications to the program (from Volume 1) are primarily for microcomputer compatibility and to provide information needed to evaluate the petitions. Default environmental and facility parameters are developed representing conservative assumptions about site selection and operational procedures. In particular, the parameters of the groundwater pathway model are modified to represent more conservative assumptions than the original model (Volume 1).

45734 **(PERG-RR—13) Health risks of nuclear and coal fuel cycles in electricity generation. A critical review of comparative assessments for the United Kingdom.** Kayes, R.J.; Taylor, P.J. (Political Ecology Research Group, Oxford (UK)). Dec 1984. 97p. British Library Lending Division, Boston Spa, Wetherby, LS23 7BQ.

A report has been prepared by the Political Ecology Research Group in which the field of comparative risk assessment of electricity generation from nuclear and coal fuel cycles is critically reviewed. Section 2 gives an introduction to risk assessments and points out the limitations of the numerical assessments that are so widely quoted. Section 3 critically reviews the major study of the UK situation, the remaining minor British studies and two American studies. Section 4 examines in detail certain areas of controversy and significance that arise in the previous section. It relates the numerical values of risk derived in Section 3 to risks in other sectors of society. Section 5 considers the significance of these estimates of risk and the conclusions are presented in section 6.

0550 Regulations

45735 **(BNL—38314) Zone approaches to international safeguards of a nuclear fuel cycle.** Fishbone, L.G.; Higinbotham, W.A. (Brookhaven National Lab., Upton, NY (USA). Technical Support Organization). 1986. Contract AC02-76CH00016. 11p. (CONF-860654—40). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014130.

From 27. annual meeting of the Institute of Nuclear Materials Management; New Orleans, LA, USA (22 Jun 1986).

At present the IAEA designs its safeguards approach with regard to each type of nuclear facility so that the safeguards activities and effort are essentially the same for a given type and size of nuclear facility wherever it may be located. Conclusions regarding a state are derived by combining the results of safeguards verifications for the individual facilities within it. We have examined safeguards approaches for a state nuclear fuel cycle that take into account the existence of all of the nuclear facilities in the state. We have focussed on the fresh-fuel zone of an advanced nuclear fuel cycle, the several facilities of which use or process low-enriched uranium. At one extreme, flows and inventories would be verified at each material balance area. At the other extreme, the flows into and out of the zone and the inventory of the whole zone would be verified. The intention is to develop an approach which will make it possible to compare the technical effectiveness and the inspection effort for the facility-oriented approach, for the zone approach and for some reasonable intermediate safeguards approaches. Technical effectiveness, in these cases, means an estimate of the assurance that all nuclear material has been accounted for.

45736 **(GAT-NM—137) Characterization of process holdup material at the Portsmouth Gaseous Diffusion Plant.** Boyd, D.E.; Miller, R.R. (Goodyear Atomic Corp., Piketon, OH (USA)). 23 Jun 1986. Contract AC05-76OR00001. 9p. (CONF-860654—39). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013557.

From 27. annual meeting of the Institute of Nuclear Materials Management; New Orleans, LA, USA (22 Jun 1986).

The cascade material balance area at the Portsmouth Gaseous Diffusion Plant is characterized by continuous, large, in-process inventories of gaseous uranium hexafluoride (UF_6) and very large

inputs and outputs of UF_6 over a complete range of ^{235}U enrichments. Monthly inventories are conducted to quantify the in-place material, but the inventory techniques are blind to material not in the gas phase. Material is removed from the gas phase by any one of four mechanisms: (1) freeze-outs which are the solidification of UF_6, (2) inleakage of wet air which produces solid uranium oxyfluorides, (3) consumption of uranium through UF_6 reaction with internal metal surfaces, and (4) adsorption of UF_6 on internal surfaces. This presentation describes efforts to better characterize and, where possible, to eliminate or reduce the effects of these mechanisms on material accountability. Freeze-outs and wet air deposits occur under abnormal operating conditions, and techniques are available to prevent, detect and reverse them. Consumption and adsorption occur under normal operating conditions and are more complex to manage, however, computer models have been developed to quantify monthly the net effects due to consumption and adsorption. These models have shown that consumption and adsorption effects on inventory differences are significant.

45737 **(SAND—86-1695C) Vehicle barrier systems.** Sena, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-860884—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014147.

From International carnahan conference on security technology; Gothenburg, Sweden (12 Aug 1986).

The ground vehicle is one of the most effective tools available to an adversary force. Vehicles can be used to penetrate many types of perimeter barriers, transport equipment and personnel rapidly over long distances, and deliver large amounts of explosives directly to facilities in suicide missions. The function of a vehicle barrier system is to detain or disable a defined threat vehicle at a selected distance from a protected facility. Numerous facilities are installing, or planning to install, vehicle barrier systems and many of these facilities are requesting guidance to do so adequately. Therefore, vehicle barriers are being evaluated to determine their stopping capabilities so that systems can be designed that are both balanced and capable of providing a desired degree of protection. Equally important, many of the considerations that should be taken into account when establishing a vehicle barrier system have been identified. These considerations which pertain to site preparation, barrier selection, system integration and operation, and vehicle/barrier interaction, are discussed in this paper. 2 tabs.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 46326

0702 Radiation Sources

45738 **(AD-A—167968/7/XAB) Workshop report: nuclear techniques for mine detection research, July 22-25, 1985, Lake Lrzerne, New York.** Moler, R.B. (Army Belvoir Research and Development Center, Fort Belvoir, VA (USA)). Jul 1985. 74p. NTIS, PC A04/MF A01.

The purpose of this workshop was to investigate the use of ionizing-radiation techniques for detecting land mines and, in particular, to identify technological advancements that would alter the assessment of the prior workshop held on March 1973. Although emphasis was placed on application of developed or emerging technology to the problem of the detection of buried land mines, detection of concealed explosives in the context of security was also considered. Automatic detection of explosives in luggage and hand-carried items received the greatest attention. Lesser attention was given to detecting explosives concealed within a building's structure. Three particular explosives detection scenarios were considered, and the requirements for each were explicitly discussed by panel members. The first of these, the detection of buried, nonmetallic, anti-vehicular mines, was the area of greatest concern and was given the greatest emphasis by the panel. The other two, detection of anti-personnel mines and detection of explosives in luggage and packages, were considered in less detail.

45739 **(DOE/AL/27458—T1) Shellfish depuration by gamma irradiation. Progress report No. 1, October 1, 1985-July 25, 1986.** Beghian, L.; Melnick, J. (Lowell Univ., MA (USA). Radiation Lab.; Baylor Univ., Houston, TX (USA). Coll. of Medicine). 25 Jul 1986. Contract FG04-84AL27458. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013887.

Objective is to investigate the feasibility of employing food irradiation technology to reduce or eliminate the threat of viral diseases contracted as a result of consumption of raw or inadequately cooked shellfish. Several recently published studies warn of the health risks associated with eating of raw shellfish - particularly American oysters, Crassostrea virginica, and the hardshelled clam, Mercenaria mercenaria. This study addresses the possibility of reducing the incidence of molluscanborne diseases through the application of ^{60}Co gamma irradiation processing to effect the inactivation of pathogenic viruses in live, raw shwllfish. Dosimetry, D_{10} doses, and organoleptic effects were studied.

45740 **(DOE/CH/10211—5) Use of gamma radiation as a form of preservation of sweet potatoes. [Final technical] quarterly progress report.** (Tuskegee Inst., AL (USA). Carver Research Foundation). [1985]. Contract FG02-84CH10211. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014153.

This document covers: harvest and conditioning following harvest, harvest-curing-storage-irradiation schemes, irradiation, control sweet potatoes, analyses, enzymes results, and procedures for taste evaluation, storage rot, weevil. (DLC)

0703 Isotopic Power Supplies

45741 **Brayton cycle space power systems.** Pietsch, A.; Trimble, S.W.; Harper, A.D. (Garrett Corp., Tempe, AZ). pp 1.446-1.451 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The latest accomplishments in the design and development of the Brayton Isotope Power System (BIPS) for space applications are described, together with a reexamination of the design/cost tradeoffs with respect to current economic parameters and technology status. The results of tests performed on a ground test version of the flight configuration, the workhorse loop, were used to confirm the performance projections made for the flight system. The results of cost-model analysis indicate that the use of the highest attainable power conversion system efficiency will yield the most cost-effective systems. 13 references.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 45590, 46138

45742 **(EUR—10152-EN) Performance tests on new electrode materials for hydrogen production by water electrolysis. Final report.** Dams, R.A.J.; Giles, R.D.; Smith, T.P. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Central Electricity Generating Board, Harrogate (UK). Scientific Services Dept.). 1986. 197p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

This report describes a programme of work to develop commercial manufacturing procedures for new electrocatalysts for the production of hydrogen by alkaline water electrolysis. The overall objective of the trial was to improve the efficiency of alkaline water electrolysis in a small low preasure electrolyser, designed to operate at 7 bar and 70°C and produce up to 1.5 Nm^3/h of hydro-

gen, using electrodes coated with Teflon bonded electrocatalysts developed from materials invented and laboratory tested at TCU. The anodic electrocatalyst was lithiated cobalt oxide, and that used on the cathode was nickel cobalt sulphide. The Teflon bonding material was chosen to improve the gas release mechanism from the electrode surfaces.

45743 **(NMERDI—2-73-4633) Hydrogen production with the electrocatalytic oxidation system. Final report.** Dhooge, P.M.; Henson, L.A. (Delphi Research, Inc., Albuquerque, NM (USA)). Jun 1986. 116p. NTIS, PC A06/MF A01 - NMERDI - Univ. of New Mexico, Suite M, 457 Washington SE, Albuquerque, NM 87108. File Number DE86901564.

A catalyzed, mediated electrochemical reaction to depolarize the anode of a hydrogen production cell was investigated. The reaction rates and activation energies for oxidation of wood chips, cattle manure and municipal sewage sludge by a number of catalyst/mediator combinations were investigated. Five combinations were chosen for extended testing in a laboratory-scale prototype reactor system, while measurements of current and potential levels, hydrogen production efficiencies, products of the biomass oxidations and catalyst/mediator solution stability were made. Results show that the process is practical and can be used in production of hydrogen from water at potentials of 1.0 volt or less. 17 refs., 20 figs., 10 tabs.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 45691

45744 **(DOE/ET—20009-T1) Full scale experimental anaerobic fermentation facility. Final report for design, construction, and operation.** (United Technologies Corp., East Hartford, CT (USA)). Jun 1981. 239p. NTIS $19.50.

Initial operation of a 25 ton/day manure-digestion facility at a feedlot in Bartow, Fla., indicates that it will be a technically and economically viable process. This report to the US Department of Energy details the design, construction, and operation of the facility.

45745 **(DOE/PC/70028—T7) Improved catalysts for liquid hydrocarbon fuels from syngas. Sixth quarterly technical progress report, January-March 1986.** (Union Carbide Corp., Tarrytown, NY (USA). Molecular Sieve Dept.). 1986. Contract AC22-84PC70028. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86014659.

The catalyst testing for this quarter was focused on further understanding and developing the X_{11} promoted cobalt oxide component intimately contacted with the Molecular Sieve TC-123. Furthermore, the addition of new promoters, the addition of a water gas shift component, and the substitution of TC-123 with a new Molecular Sieve TC-121 and with γ-alumina was also studied. The use of the additional promoter X_{13} was found to increase the water gas shift activity of the X_{11} promoted Co/TC-123 catalyst. While the catalyst demonstrated excellent stability at 240C, it did, however, show considerable deactivation at 260C. The use of the additive X_9, geared towards improving the Co/S_{11}/TC-123 catalyst's stability at higher temperatures, appeared partially successful. The catalyst demonstrated high activity (about 75 percent CO + H_2 conversion at 260C, 500 psig, and a 1.5:1 H_2:CO) with a deactivation rate of only about one percentage point every 150 hours. The selectivity, however, remained excellent with about 9 percent CH_4 being produced throughout the 800 hour test period. Attempts to improve the water gas shift activity of the system by the simple addition of a separate water gas shift catalyst (K/Ni/Mo-γ-alumina) were unsuccessful. Similarly, the testing of the new Molecular Sieve TC-121 demonstrated inferior performance in both activity and selectivity when compared with the analogous TC-123 supported catalyst. The preliminary test results for these catalysts are summarized in Appendix A.

45746 **(DOE/PC/70809—T10) Microbial screening test for lignite degradation. Quarterly progress report No. 6, April-June 1986.** Yen, T.F. (University of Southern California, Los Angeles (USA)). 1986. Contract FG22-84PC70809. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013551.

Nitration followed by reduction has been used to directly incorporate amino groups into the macromolecular structure of lignite. This nitrogen enriched lignite was subjected to biodegradation. Since oxidation was accompanied with nitration, it is believed that a significant portion of nitrogen was evolved as NO_2. In order to avoid severe oxidation, nitronium salt such as nitronium tetrafluoroborate is recommended as the reagent for the nitration of lignite. Biodegradation of the methanol soluble fraction has been assessed. The solutions under investigation were analyzed by ion chromatography in order to determine the character of the biodegradation products of the bacterial species RC-W and RC-P, which were isolated in previous work. A new method of lignite modification is under development. Sodium metal was used to decompose methanol. The anions produced from this reaction attack the active sites present in the structure of lignite. FT-IR and FT-NMR were used to investigate the structured features of modified lignite. It is known that the activity of enzymes can be inhibited by the presence of sulfide. Elimination of sulfide content was carried out to assess the effect of sulfide on the biodegradation of lignite. 11 refs., 5 figs.

45747 **(EUR—9943-EN) Methane production by mariculture on land. Final report.** Wagener, K. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Technische Hochschule Aachen (Germany, F.R.)). 1985. 22p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

It was the aim of this program to have the whole cycle running, consisting of algae production, harvesting, fermentation to biogas, and mineral nutrient recycling into the algae ponds in the form of the fermentation residue (sludge). For this purpose two pilot ponds with a total area of 160 m^2 have been installed and operated which provided a lot of new experience and success in this new field: concerning pond regime, harvesting procedure and species control. As a preparatory step for the fermentation at pilot scale (which is a subject of the next period), the anaerobic digesteability of micro and macro algae was tested at the laboratory scale. The recycling of unoxidized fermentation sludge directly into the algae ponds has successfully been tested over a period of 4 months; it was finished by seasonal circumstances in November 1981. Finally, the productivities of 3 different algal strains, candidates for energy farming, were tested and compared. Tetraselmis showed the highest productivity yielding 65 tons/ha/yr, followed by Oscillatoria with about 88% of this, and Ulva with 68%. It seems, however, that with the last species the optimal yield has not yet been reached.

45748 **(PB—86-203361/XAB) Thermophysical properties of fluids for the gas industry. Annual report, January-December 1985.** Haynes, W.M. (National Bureau of Standards, Boulder, CO (USA). Thermophysics Div.). 21 Apr 1986. 379p. NTIS, PC A17/MF A01.

The report summarizes work carried out in calendar year 1985 in the Properties of Fluids Group, Thermophysics Division, National Bureau of Standards, Boulder, Colorado that was supported by the Gas Research Institute. The most important results included viscosity data for CO_2 + ethane mixtures; fugacity data for H_2 mixtures; development of sound-speed apparatus for measurements on gases to 10 MPa at temperatures from 250 to 350 K; sound-speed data for equimolar methane + ethane mixture; and theoretical studies of the extended corresponding states model, of mixing rules in conformal solution theory, and of the mean density approximation for molecules that differ greatly in size. The overall philosophy and technical resources of the group are discussed. Plans for the future are noted.

45749 **(PNL-SA—13853) Energy recovery from aquatic biomass in a thermochemical reactor.** Butner, R.S.; Elliott, D.C.; Sealock, L.J. Jr. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 18p. (CONF-860709—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014376.

From Conference on research and applications of aquatic plants for water treatment and resource recovery; Orlando, FL, USA (20 Jul 1986).

A series of experiments has been conducted to study the conversion of water hyacinths and macrocystis kelp to gaseous and liquid energy products in a catalytic thermal reactor. Treatment of the water hyacinths and kelp at 400-450°C in the presence of nickel and alkali catalysts resulted in moderate yields of medium-heating value (9.2-11.1 MJ/std m^3) gas. The gas was composed primarily of hydrogen, carbon dioxide, methane and other light hydrocarbon gases. Treatment of the same materials at lower temperatures (350°C) with the addition of an alkali catalyst only resulted in the production of both water soluble and water-insoluble organic material. Analysis of the resulting oils indicates that their chemistry is significantly different from oils produced by treating other lignocellulosic feedstocks under similar conditions. These differences have practical implications with regards to the utilization of the oils. 6 refs., 5 tabs.

45750 **Methane suppression from metal-zeolite catalysts in synthesis gas conversion.** Rao, V.U.S.; Gormley, R.J.; Schehl, R.R.; Chi, R.D.H.; Obermyer, R.T. (US Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 1, 169(Mar 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

The mechanism of synthesis gas conversion over cobalt-ZSM-5 catalysts to gasoline range hydrocarbons has been examined. There is a correlation between the methane yield and the percent aromatics in the liquid hydrocarbon product. This can be traced through the formation of additional alkanes (C_3H_8 and C_4H_{10}) accompanying the aromatization process. The alkanes undergo hydrogenolysis over cobalt leading to the formation of additional methane. The bifunctional catalysts 4.2% Co/SiO_2 + ZSM-5 made 1.7 times as much methane as Co/SiO_2 with a feed of H_2/CO = 1 at 280°C, 21 atm, and WHSV = 0.77. Under similar process conditions, 6.3% Co, 0.05% Cu/SiO_2 + ZSM-5 made nearly the same amount of methane as 6.3% Co, 0.05% Cu/SiO_2. Thus the addition of Cu to Co lowered the additional methane formation by reducing the rate of hydrogenolysis. C/sub 5+/ yield with the bifunctional catalyst increased from 72% to 76% upon the addition of Cu.

45751 **Studies of carbon deposition and consumption on Ru/TiO_2 during Fischer-Tropsch synthesis.** Yokomizo, G.; Bell, A.T.; Duncan, T.M. (Materials and Molecular Research Div., Lawrence Berkeley Lab. and Dept. of Chemical Engineering, Univ. of California, Berkeley, CA). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 1, 182(Mar 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

Isotropic tracer techniques have been used to characterize the dynamics of carbon deposition on the surface of a Ru/TiO_2 catalyst during Fischer-Tropsch synthesis and ^{13}C-NMR spectroscopy has been used to characterize the structure of the deposited carbon. Elemental carbon, designated C/sub α/ is formed very rapidly, whereas alkyl carbon, designated C/sub β/ accumulates much more slowly. The influence of catalyst reduction on temperature, reaction conditions, and time under reaction conditions on the surface concentrations and reactivity of C/sub α/ and C/sub β/ will be discussed. It will be shown that C/sub β/ progressively becomes less reactive and may be the precursor to the formation of graphitic carbon.

45752 **Manganese oxide as a promoter for C_2-C_4 olefin production in the hydrogenation of carbon dioxide.** Kim, C.; Chen, K.; Hanson, F.V.; Oblad, A.G.; Tsai, Y. (Dept. of Fuels Engineering, Univ. of Utah, Salt Lake City, UT). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 1, 198-207(Mar 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

A number of active research and development programs have been initiated to explore the potential of CO hydrogenation process as a source of low molecular weight (C_2-C_4) olefins. Metal catalysts such as Co-Mn, Ni-zeolite, Rd and Mo have been evaluated for low molecular weight olefin selectivity. The coprecipitated Fe-Mn system (Mn/Fe=9/1) was reported to be highly olefin selective. Recently, many investigators reported supporting evidence for the promotional effect of Mn for precipitated Fe catalysts. In this study, Raney Fe promoted with Mn has been evaluated for C_2-C_4 olefin selectivity in the hydrogenation of CO relative to coprecipitated Fe-Mn catalysts. Catalyst characterization, including BET surface area, X-ray diffraction, selective chemisorption and ESCA, has been carried to provide insight into the role of manganese in both the Coprecipitated and Raney catalyst systems.

45753 **The influence of TiO/sub x/ promoters on the chemisorption and hydrogenation of CO on polycrystalline Rh.** Levin, M.; Bell, A.T.; Salmeron, M.; Somorjai, G.A. (Materials and Molecular Research Div., Lawrence Berkeley Lab.; Dept. of Chemical Engineering and Chemistry, Univ. of California, Berkeley, CA). *American Chemical Society, Division of Petroleum Chemistry, Preprints;* **31**: No. 1, 317(Mar 1986). (CONF-860425—).

From 191. American Chemical Society national meeting; New York, NY, USA (13 Apr 1986).

A study has been conducted of the influence of TiO/sub x/ moieties deposited on the surface of a polycrystalline Rh foil on the chemisorption and hydrogenation of CO. With increasing TiO/sub x/ coverage, the coverage by CO falls off faster than expected for simple site blockage and the overall strength of CO adsorption is weakened. The rate of CO methanation passes through a maximum at a TiO/sub x/ coverage of 15%. At the maximum, the rate of methane formulation is more than ten-fold greater than that observed for clean Rh. It is also found that with increasing TiO/sub x/ coverage, an increasing proportion of C^+_2 products are formed and the olefin to paraffin ratio rises. All of these effects are discussed in terms of a model of the TiO/sub x/-decorated Rh surface.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 45606

45754 **(CONF-860405—6) Fermentation of lignocellulosic feedstocks: product markets and values.** Gaines, L.L.; Karpuk, M. (Argonne National Lab., IL (USA); Solar Energy Research Inst., Golden, CO (USA)). 1986. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014580.

From 10. annual symposium on energy from biomass and wastes; Washington, DC, USA (7 Apr 1986).

Ethanol is the primary product of biomass hydrolysis and fermentation processes. The quantity and quality of coproducts depend on the feedstock and on the process steps employed. When the feedstock is lignocellulosic - wood or herbaceous energy crops, such as napier grass or kenaf - substantial quantities of lignin and five-carbon sugars and derivatives are produced, and the sale of these and other coproducts has a potentially large impact on the economics of fuel alcohol production. For each product, potential markets and materials competing for these markets (or competing routes to the same product) are identified. The value of ethanol as a chemical, octane enhancer, and fuel is estimated. Coproduct credits are calculated, and the potential benefits resulting from coproduct recovery are estimated. The quantity of each material that could be produced by fermentation is compared with the size of potential markets. Where coproducts of substantial fuel ethanol manufacture could saturate their markets, the question of whether early sales

could serve as a wedge to ethanol market penetration is addressed. 20 refs., 7 figs., 3 tabs.

45755 (NIPER—101) Effect of methanol fuel formulations on exhaust products. Status report. Wares, R.N. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). 11 Sep 1985. Contract FC22-83FE60149. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014738.

Five methanol fuels were utilized in two Ford Escorts specifically designed for neat methanol consumption. The methanol-based fuel blends contained up to 30% hydrocarbons by volume and covered a wide range of volatility. Exhaust emission results show small changes in HC and NO/sub x/ emissions with the addition of hydrocarbons to methanol. Blends containing high vapor pressure Indolene exhibited large increases in CO. For both vehicles, aldehydes were decreased with the displacement of methanol by Indolene. Addition of a 15 volume-percent low Reid vapor pressure (RVP) Indolene produced the highest volumetric fuel economy. Evaporative emissions were lowest with neat methanol as fuel and up to 250% higher with the addition of 30-volume-percent Indolene with RVP modified to a higher level. No driveability problems occurred with any of the fuels in these automobiles. 8 tabs.

45756 (PB—86-198538/XAB) Development of methanol cracking processes. Murakami, M.; Imai, T.; Tamai, M.; Yanagi, M.; Miyairi, Y. (Mitsubishi Heavy Industries Ltd., Tokyo (Japan)). 1986. 8p. (In Japanese). NTIS, PC A06/MF A01).

The process by which methanol is decomposed into carbon monoxide and hydrogen gas in the catalytic-cracking reaction is considered to be applicable to a variety of fields, such as for methods producing materials for C1 chemistry or supplying new energy sources for city gas, etc. The needs for the practical application of the process will increase more intensely than before with a stabilized methanol supply and reducing its cost. Since the R & D work, catalysts for methanol cracking in 1979, the authors have devoted themselves to the development of the process further through micro-reactor tests and bench-scale tests, have confirmed the advantage of the process by pilot-plant operations in 1984, and obtained techniques for the practical application of the process. The new mini-plant was constructed based on the test results of the process obtained so far, and sales activity is being deployed. The report presents: (1) features of the catalyst for methanol cracking developed by MHI; (2) features and product yield of the methanol cracking reaction; (3) simulator for optimum design of reactors for methanol cracking; (4) operatability of the plant; and (5) feasibility studies of commercial plants.

45757 Progress in the Laporte LPMEOH PDU project. Mednick, R.L.; Klosek, J. New York, NY; American Institute of Chemical Engineers (1986). 18p. (CONF-860447—).

From American Institute of Chemical Engineers spring national meeting; New Orleans, LA, USA (6 Apr 1986).

The technology development path that led to LaPorte has included two reactor modes: an ebullated-bed (also called liquid-fluidized) reactor which uses an expanded bed of catalyst extrudates, and a slurry (also called liquid-entrained) reactor where the catalyst is dispersed in powder form. Research on the liquid-fluidized system was begun by Chem Systems in 1975 using a 2.5-cm diameter by 1.8-m high bench-scale reactor. Development subsequently progressed through an intermediate-scale lab PDU and then to the Laporte PDU. The LaPorte PDU has a reactor approximately 0.6-m in diameter by 5.5-m high and a nominal capacity of 4.5 metric tons per day of methanol. Research on the liquid-entrained system began in 1979 in stirred autoclaves and then progressed through an intermediate scale lab PDU to the LaPorte PDU.

45758 Method and apparatus for synthesizing hydrocarbons. Colmenares, C.A.; Somorjai, G.A.; Maj, J.J. (to Dept. of Energy). US Patent Application 6-723,713. 16 Apr 1985. 28p. Contract W-7405-ENG-48. DE86013805 NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013805.

A method and apparatus for synthesizing a mixture of aliphatic alcohols having five carbons or less is disclosed. An equal molar ratio of CO and H_2 gases is caused to pass through a ThO_2 catalyst having a surface area of about 80 to 125 m^2/g. The catalyst further optionally includes Na ions present as substitutional cations in an amount of about 5 to 10 atom %. At a temperature of about 570 to 630°K, and at pressures of about 20 to 50 atm, methanol and isobutanol are the predominant products and are produced in amounts of about 90 wt % of the total hydrocarbon mixture. 6 figs.

13 HYDRO ENERGY

1303 Plant Design And Operation

45759 (EPRI-EM—4599-Vol.1) Ultrahigh head pump/turbine development program. Volume 1. Technical summary. Final report. Yokoyama, T. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works). Jul 1986. 449p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920430.

The commercial availability of an ultrahigh head pump/turbine whose output can be regulated makes underground and ultrahigh head-pumped storage creditable options for utility use by reducing construction costs and plant complexity. This new turbine operates at double the head of existing equipment yet uses commercial materials, proven design concepts, and manageable manufacturing techniques.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 46684

45760 (DOE/BP/11548—1) Hells Canyon environmental investigation. Final report. (USDOE Bonneville Power Administration, Portland, OR. Office of Power and Resources Management). Jan 1985. Contract AC79-83BP11548. 306p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86013878.

The Water Budget plan would provide additional flows in the Columbia and Snake Rivers between April 15 and June 15 to improve the survival of downstream migrating salmon and steelhead. The plan calls for 20,000 cubic feet per second-months (beyond the firm power flow) to be delivered to Lower Granite pool as the Snake River contribution to the Water Budget. This water would come from Idaho Power Company's (IPCo) Hells Canyon Complex (principally, Brownlee Reservoir) and the US Army Corps of Engineers' Dworshak Reservoir. This report contains the results of an environmental investigation of the nonpower impacts on the Hells Canyon Complex investigation. The environmental investigation evaluated three Water Budget scenarios, or levels of participation, developed by IPCo. These scenarios involve drawdowns of Brownlee Reservoir to three elevations, or floor levels (2036, 2050, and 2065), for Water Budget flows. A total of nine discipline areas were studied. These include natural features (geology); water use; water quality; fish, botanical, and wildlife resources; air quality; land use; historical and archeological resources; recreational resources; and aesthetic resources. Within each discipline, the report presents the existing conditions, the potential impacts associated with each scenario, information deficiencies and needed studies, and references.

45761 (PNL-SA—13422) Fisheries evaluation of fish screening facilities in the Yakima Basin, Washington. Neitzel, D.A.; Abernethy, C.S. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 7p. (CONF-860757—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013595.

From Western Division of the American Fisheries Society annual meeting; Portland, OR, USA (21 Jul 1986).

Diversion screens constructed in the Sunnyside Dam and Canal were evaluated to determine if scale loss occurred to fish during passage through the screen facility. (ACR)

14 SOLAR ENERGY

1401 Resources And Availability

45762 Method and apparatus for measuring solar radiation in a vegetative canopy. Gutschick, V.P.; Barron, M.H.; Waechter, D.A.; Wolf, M.A. (to Dept. of Energy). US Patent Application 6-729,022. 30 Apr 1985. 13p. Contract W-7405-ENG-36. DE86013710 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013710.

An apparatus and method for measuring solar radiation received in a vegetative canopy. A multiplicity of sensors selectively generates electrical signals in response to impinging photosynthetically active radiation in sunlight. Each sensor is attached to a plant within the canopy and is electrically connected to a separate port in a junction box having a multiplicity of ports. Each port is connected to an operational amplifier. Each amplifier amplifies the signals generated by the sensors. Each amplifier is connected to an analog-to-digital convertor which digitizes each signal. A computer is connected to the convertors and accumulates and stores solar radiation data. A data output device such as a printer is connected to the computer and displays the data.

1403 Economics

REFER ALSO TO CITATION(S) 45786, 45787

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 45744, 45747

45763 (DOE/CE/15239—T3) Photovoltaic membrane (PVM) roof system. Second quarter technical progress report, 1986. Francovitch, T.F. (Single-Ply Inst. of America, Inc., Pasadena, MD). 25 Jul 1986. Contract FG01-85CE15239. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013244.

A roof construction has a substantially flat, horizontal substrate, which may be of insulating material, having mounted thereon at least one structure having an inclined surface. A membrane of water-impervious material extends over the substrate and over the structure. The portion of the membrane covering the inclined surface of the structure has photocells thereon, the inclination and orientation of the inclined surface being selected for maximum radiation reception from the sun. The structure may be of generally triangular shape, is thermally insulating, and a plurality of parallel structures may be provided, with photocells on parallel, inclined surfaces. The structures may have additional surfaces which are opposite and facing the first mentioned surface of an adjacent structure, which additional surface or surfaces is provided with a reflective film for reflecting radiation into the photocells of the adjacent structure.

45764 (EUR—10014-EN-FR) Methane production by anaerobic digestion of algae. Final report. Asinari di San Marzano, C.M.; Collard, F.; Dujardin, E.; Legros, A.; Naveau, H.; Nyns, E.J.; Sironval, C. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Louvain Univ. (Belgium)). 1985. 146p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

The objective of the five year period covered by this summary was to assess the possibility to obtain methane from algae by anaerobic digestion. A 1 m^3 pilot plant was set up in Lamezia-Terme (Calabria, Italy) with the algae Tetraselmis. It was the first biogas pilot plant working on an energy crop in Europe. The following design data could be computed: 10 ha ponds will produce daily 1.7 t algal dry mass to be biomethanized in a once-through methane digester of 340 m^3 working volume, producing daily 600 m^3 biogas (15-6 GJ). The overal system is an elegant socio-economical solution to the energy needs of rural communities in arid mediterranean areas. The biogas plant, taken alone, meets the basic requirements for economical feasibility.

45765 (EUR—10146-IT) Utilization of forest biomass for energy production and industrial purposes. Final report. Scaramuzzi, G. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 61p. (In Italian). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energia.

The project is part of a larger one promoted by the Italian Agency for Cellulose and Paper (E.N.C.C.) for an enhanced utilization of coppice forests in Italy. It concerns a Turkey oak (Quercus cerris) stand in Calabria. Stand characteristics and results of harvesting trials, first after-felling observations and technological investigations are reported. Results of an estimate of coppice forests biomass availability and of possibilities of expanding its use for energy are also given. Machinery damage to stumps was greatly reduced (1.7% of high-damaged stumps) by sprouts concentration by skyline. Sprouts weight appeared as a major factor affecting harvesting yield, Harvesting costs varied with different stand and terrain characteristics from 28,000 to 39,500 It. liras/t. Because of the high transport costs, the use of current coppice forests biomass is restricted within a short distance from the harvesting area. Industrial trials for fiberboard and paper pulp production from coppice whole-tree chipped biomass proved the possibility of its use in mixture with current raw material up to 75% for fiberboard production and up to 35-50% for corrugated paper pulp production. Relative expansion possibilities of coppice forest biomass consumption for energy were estimated, mainly localized in the central-northern Appennine and the Alpine areas. Given the permanence of a high convenience for its home consumption, wide development programs for coppice biomass industrial use for energy appear to be inconvenient. On the other hand, its use by local communities (schools, hospital, etc.) might be incentived in particular areas with high coppice production potential far from wood industries.

45766 (EUR—10147-EN) Pressurized gasification test facility. Construction. Final report. Wilson, H.T. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation; Foster Wheeler Power Products Ltd., London (UK)). 1985. 80p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

This document summarises the key design elements associated with the construction of a test plant for pressurised gasification of biomass, to be used to establish future operational parameters and process equipment specifications for commercial facilities. It is a multi-functional plant which not only permits operation with selected parameters such as temperature, pressure, flow rates and so on, but also alteration of the reactor geometry and type within the system. The value of theoretical studies has been highlighted as a means of reviewing wide ranging experimental programmes, both for information and selecting potential experimental areas. The parallel theoretical studies which were derived from extensive general experience, related to chemical equilibrium in the carbon hydrogen oxygen system, show quite clearly that there is little merit in designing a test plant of this kind to operate at pressures in excess of 10 bars, due to an invariance in product gas composition which develops beyond the 10 bar pressure level.

45767 (SERI/STR—211-2962) Research on single-crystal CdTe solar cells. Annual subcontract report, 1 February 1985-1 February 1986. Borrego, J.M.; Ghandhi, S.K. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Jun 1986. Contract AC02-83CH10093. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86010719.

This report outlines work carried out during Phase I of growth and characterization of single-crystal CdTe layers to explore their potential in high-efficiency solar cells. High-quality InSb layers can be grown by organometallic vapor phase epitaxy (OMVPE). Layers have been grown whose photoluminescence peak has a full width half maximum of 5.8 MeV, the lowest value achieved to date in epitaxial layers of this compound semiconduc-

tor. CdTe layers with featureless morphology were grown at 350° to 420°C. All layers are n-type. A hole lifetime of 1.5 micrometers was measured by optical techniques and corroborated by DLTS measurements. Both Schottky and p^+-n junction cells have been made on these layers. Device characteristics are contained in the report.

45768 **(SERI/STR—211-2972) Tandem thin-film solar cell using Cd/sub y/Zn/sub 1-y/Te as the wide bandgap component. Annual subcontract report, 1 April 1985-1 April 1986.** Zanio, K. (Ford Aerospace and Communications Corp., Newport Beach, CA (USA)). Jun 1986. Contract AC02-83CH10093. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86010720.

The objective of this research program was to develop CdZnTe as the wide-bandgap component for all-thin-film, polycrystalline tandem solar cell. Single-crystal and polycrystalline CdZnTe films containing about 0.20 mole fraction of ZnTe corresponging to a bandgap of 1.65 eV were deposited by congruent evaporation in uhv on sapphire and ITO/glass substrates. CdZnTe and single-crystal CdTe films, semi-insulating as grown films, were annealed to p-type in Te overpressures. The Hall mobilities and carrier concentration ranges for the films were respectively 20 to 75 $cm^2/V\text{-}s$ and 5 x 10^4 - 10^{16} cm^{-3}. The use of Hg(Cd,Zn) Te alloys reduced contact resistances as low as 0.1 ohm-cm^2. Indium Schottky barriers of 0.9 eV were observed on CdZnTe single-crystal thin films.

45769 **Voltage and light bias-dependent spectral response of the $CuInSe_2$/Cd(Zn)S thin-film solar cell.** Eron, M. (RCA David Sarnoff Research Center, Princeton, New Jersey 08543-0432). *Journal of Applied Physics;* 60: No. 6, 2133-2136(15 Sep 1986).

In this paper, experimental results of bias- and light-dependent spectral response measurements of $CuInSe_2$/Cd(Zn)S thin-film solar cell and its consequences are discussed. The dc measurements are analyzed in light of new data and their consistency with chopped light measurements are reiterated. Experimental evidence also suggests that, at least in some cells, at high forward bias, reversal of photocurrent occurs. Present models for the bias- and light-dependent collection factor are also reviewed.

45770 **Apparatus for converting biomass to a pumpable slurry.** Ergun, S.; Schaleger, L.L.; Wrathall, J.A.; Yaghoubzadeh, N. (to Dept. of Energy, Washington, DC). US Patent 4,597,832. 1 Jul 1986. Filed date 1 Oct 1981. vp.

An apparatus is described for converting lignocellulosic material to a pumpably slurry comprising: means for receiving material to be converted, means for pressurizing he material to be converted, heated means operatively connected to the receiving means and the pressurizing means and having no moving mechanical elements therein for treating the material under pressure and temperature for a period of time, means operatively connected to the heated treating means for recirculating at least a portion of the treated material through the heated treating means, and refining means operatively connected to receive a portion of the treated material from the recirculating means for producing finely ground particles of the treated material.

45771 **Superlattice photoelectrodes for photoelectrochemical cells.** Nozik, A.J. (to Dept. of Energy). US Patent Application 6-751,413. 3 Jul 1985. 45p. Contract AC02-83CH10093. DE86013695 NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013695.

The application of superlattice semiconductors as photoelectrodes in photoelectrochemical energy conversion processes is described. The invention is comprised of a multiple quantum well, or superlattice, semiconductor positioned on a plate and encapsulated in an insulation material, except the top surface, which is left exposed. An opening in insulation exposes a portion of the plate. When the photoelectrochemical cell is immersed in a liquid electrolyte and exposed to solar radiation, a redox reaction occurs, producing gases such as hydrogen and oxygen from a water electrolyte, which bubble off the cathode and anode portions of the cell. (LEW)

45772 **Development and testing of advanced fire-resistant photovoltaic modules.** Sugimura, R.S.; Otth, D.H.; Ross, R.G. Jr. (California Institute of Technology, Pasadena). pp 337-343 of Institute of Environmental Sciences, Annual Technical Meeting, 31st, Las Vegas, NV, April 30-May 2, 1985, Proceedings. Mount Prospect, IL; Institute of Environmental Sciences (1985). (CONF-850450—).

From 31. annual meeting of the Institute of Environmental Sciences; Las Vegas, NV, USA (29 Apr 1985).

The evaluation of back-surface materials flammability in order to identify fire resistant module designs is examined. The fire test apparatus, burning-brand test sequence, and spread-of-flame test sequence are described. Video recordings and time-temperature profiles of module back surfaces are utilized to study the flammability failure mechanism and identify high-temperature materials. A table of flammability test results for various module designs is provided. The data reveals that 2-mil kapton, fiberglass cloth coated or impregnated with a material to plug pores, and metal foil back-surface materials achieve class A and B fire-resistance levels, and are applicable for photovoltaic module designs. 6 references.

45773 **Potential of thin-film solar cell module technology.** Shimada, K.; Ferber, R.R.; Costogue, E.N. (California Institute of Technology, Pasadena). pp 3.460-3.465 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

During the past five years, thin-film cell technology has made remarkable progress as a potential alternative to crystalline silicon cell technology. The efficiency of a single-junction thin-film cell, which is the most promising for use in flat-plate modules, is now in the range of 11 percent with 1-sq cm cells consisting of amorphous silicon, $CuInSe_2$ or CdTe materials. Cell efficiencies higher than 18 percent, suitable for 15 percent-efficient flat plate modules, would require a multijunction configuration such as the CdTe/$CuInSe_2$ and tandem amorphous-silicon (a-Si) alloy cells. Assessments are presented of the technology status of thin-film-cell module research and the potential of achieving the higher efficiencies required for large-scale penetration into the photovoltaic (PV) energy market. 10 references.

45774 **Liquid junction photovoltaic devices utilizing organic thin film electrodes.** SLinkous, C.A.; Armstrong, N.R. (Brookhaven National Lab., Dept. of Applied Science, Building 801, Upton, NY 11973). pp 384-388 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

The application of organometallic phthalocyanines as p-type semiconductors in photoconductive and photovoltaic devices is described. The advantages of liquid junction photovoltaic devices are also described. Preliminary voltammetric data exemplifying types of photoresponse far various phthalocyanine derivatives are given.

1406 Photovoltaic Power Systems

45775 **Power conditioning subsystems for photovoltaic central-station power plants - technology and performance.** Krauthamer, S.; Das, R.; Bulawka, A. (California Institute of Technology, Pasadena; California State Univ., Long Beach; DOE, Washington, DC). pp 3.438-3.443 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Central-station photovoltaic (PV) systems have the potential of economically displacing significant amounts of centrally generated electricity. However, the technical viability and, to some extent, the economic viability of central-station PV generation technology will depend upon the availability of large power conditioners that are efficient, safe, reliable, and economical. This paper is an over-

view of the technical and cost requirements that must be met to develop economically viable power conditioning subsystems (PCS) for central-station power plants. The paper also examines various already commercially available PCS hardware that may be suitable for use in today's central PV power stations. 10 references.

45776 **Status of utility-interactive photovoltaic power conditioning technology.** Key, T.S.; Krauthamer, S. (Sandia National Labs., Albuquerque, NM; California Institute of Technology, Pasadena). pp 3.444-3.449 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Design options for utility-interactive photovoltaic power conditioning technology for unit ratings from 2kW to 5 MW are compared. Line- and self-commutated inverter designs for both single and three-phase applications are described. Efficiency, weight, and cost projections are provided for comparing the design options. New circuit designs that take advantage of advances in power semiconductor devices are found to be the most promising. Hardware efficiencies from 95 percent for single phase to 98 percent for three-phase applications are found. 7 references.

45777 **Using PVFORM, a systems performance model, to determine optimum mounting configurations for flat-plate photovoltaic modules.** Menicucci, D.F. (Solar Energy Dept., Sandia National Labs., Albuquerque, NM). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 232-241(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The performance of a photovoltaic (PV) system is affected by the particular mounting configuration selected. But the optimal configuration for various potential designs is unknown because too few PV systems have been fielded. Sandia National Laboratories (SNL) is currently conducting a controlled field experiment in which four of the most commonly used module-mounting configurations are being compared. The data from the experiment are used to verify the accuracy of PVFORM, a new PV performance model. The model is then used to simulate the performance of PV modules mounted in different configurations in eight sites throughout the US. This paper describes the module-mounting configurations, the experimental methods used, the specialized statistical techniques used in the analysis, and the final results of the effort. The module-mounting configurations are rank ordered at each site according to their energy production performance, and each is briefly discussed in terms of its advantages or disadvantages in various applications.

1407 Solar Thermal Power Systems

45778 **(SAND—85-8184) Solar reformer experiment design study.** Rozenman, T. (Resource Analysis International, Inc., Los Angeles, CA (USA)). Jul 1986. Contract AC04-76DR00789. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014744.

This report describes the design of an experiment in which solar energy is provided to a steam-hydrocarbon reforming reactor placed inside a solar central receiver. The hardware design, process, operation options with the possible critical issues are analyzed. Included also is the construction cost estimate and a development plan.

45779 **(SAND—86-8002) Total capital cost data base: 10MWe Solar Thermal Central Receiver Pilot Plant.** Norris, H.F. Jr. (Sandia National Labs., Livermore, CA (USA)). May 1986. Contract AC04-76DR00789. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86011388.

This report describes the total capital cost data base of the 10 MWe Solar Thermal Central Receiver Pilot Plant. This Solar One cost data base was created using the computer code "Cost Data Management System (CDMS)". The cost data base format was developed to be used as a common method of presentation of capital costs for power plants. The basic format is a plant system cost breakdown structure. Major accounts are land; structures and improvements; collector, receiver, thermal transport, thermal storage, and stream generation systems; turbine plant; electrical plant; miscellaneous plant systems and equipment; and plant-level indirect costs. Each major account includes subaccounts to as many as nine level of detail. The data base can be accessed to provide elements-of-work costs at any subaccount level or at the plant level. The elements-of-work include sitework/earthwork; concrete work; metal work; architectural; process equipment; piping; electrical; and miscellaneous work. Each of these elements-of-work can be or are broken into finer detail and costs can be accumulated to identify more specific needs, e.g., pipe insulation or heat exchangers. The cost data base can be accessed and various reports can be generated. These vary from a single page summary to detailed listings of costs and notes. Reported costs can be stated in dollars, dollars per kilowatt or percentage of the total plant cost. Reports or samples of reports for the pilot plant capital cost are included.

45780 **(SAND—86-8011) Utilizing spreadsheets for analyzing solar thermal central receiver power plant designs.** Norris, H.F., Jr. (Sandia National Labs., Livermore, CA (USA)). Jul 1986. Contract AC04-76DR00789. 73p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86013372.

Spreadsheets have been used to collect and understand existing solar thermal central receiver design data. Correlation of these data has led to the development of many useful algorithms. The algorithms provide the basis for calculating performance efficiencies, annual energy production, plant cost, and levelized energy cost. Variations in design details are evaluated with example results of the effect of plant location, collector field dield size, efficiencies for North and surround configurations as a function of field size, efficiencies of external and cavity receivers for similar operating conditions, and interactions of the collector field and receiver design. Examples are also presented for the plant total capital investment and levelized energy cost as a function of the annual energy produced. Sensitivities to various parameters affecting the net annual energy production and levelized energy cost are also discussed. The performance and cost characteristics of large and small plants are considered. Use of the spreadsheet analysis is demonstrated where one possible design utilizes modular solar systems. The design includes a single steam generator and turbine plant. This optimizes the performance and cost attributes of both small solar and large non-solar systems to arrive at a more cost-effective plant.

45781 **Advanced latent heat of fusion thermal energy storage for solar power systems.** Phillips, W.M.; Stearns, J.W. (California Institute of Technology, Pasadena). pp 2.384-2.391 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The use of solar thermal power systems coupled with thermal energy storage (TES) is being studied for both terrestrial and space applications. In the case of terrestrial applications, it was found that one or two hours of TES could shift the insolation peak (solar noon) to coincide with user peak loads. The use of a phase change material (PCM) is attractive because of the higher energy storage density which can be achieved. However, the use of PCM has also certain disadvantages which must be addressed. Proof of concept testing was undertaken to evaluate corrosive effects and thermal ratcheting effects in a slurry system. It is concluded that the considered alkali metal/alkali salt slurry approach to TES appears to be very viable, taking into account an elimination of thermal ratcheting in storage systems and the reduction of corrosive effects. The approach appears to be useful for an employment involving temperatures applicable to Brayton or Stirling cycles. 6 references.

45782 **Numerical study of the performance of latent heat storage for solar dynamic power systems.** Solomon, A.D. (Oak Ridge National Lab., TN). pp 2.392-2.396 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The structure and theoretical foundation of a simulation code for heat transfer and storage in an idealized storage module which forms part of a Brayton cycle solar power system are described. The underlying physical system is shown, and the advantages, drawbacks, and possible pitfalls of latent heat thermal energy storage are discussed. Some possible designs of a latent heat thermal energy storage module are examined. Preliminary results obtained by using analytical approximations which are crucial to homing in on potential system configurations are reported and examined using the simulation code. 20 references.

1408 Ocean Energy Systems

45783 **(AD-A—167702/0/XAB) Ocean thermal conversion (OTEC) project bottom cable protection study. Analysis and selection of protection techniques.** (Naval Facilities Engineering Command, Washington, DC (USA). Chesapeake Div.). Oct 1981. 84p. (CHES/NAVFAC-FPO—1-81(20)). NTIS MF A01.

General guidelines and procedures for cable protection are given for the four proposed Ocean Thermal Energy Conversion (OTEC) plant sites and cable routes, together with seafloor scenarios and protection strategies for each site. Burial of the cable below the seafloor is the recommended and best method of protecting OTEC cables from the hazards existing at all sites, namely, chafe and corrosion, hydrodynamic forces, trawler/dredge, and ship anchor. For landslides and earthquakes the only feasible method of protection, although limited, is to provide slack, in the cable, i.e. lay extra length. Trenches for burying the cable are recommended to be constructed a) by blasting through hard bottom at Hawaii for the first nautical mile (n.m.) and at Puerto Rico for the first 0.9 n.m; b)by a plowing machine at Hawaii for the next 0.5 n.m.; c) by a trenching machine at Guam for the first 0.55 n.m.; d) by a trenching /laying machine at Florida for 110 n.m.; and e) by a conventional floating dredge for 15 n.m. For the outshore segments of the cable routes it is recommenced to lay the cable on th seafloor because bottom sediments are soft enough to permit the cable to bury itself. Except for the Florida route, a normal cable laying vessel is recommended for laying the cable from plant site to landfall and for performing the protection details which are temie concrete cover over the cable at Hawaii for 0.5 n.m. and split pipe and rock anchor at Puerto Rico for 012 n.m.

45784 **(SERI/TP—253-2965) Potential of proposed open-cycle OTEC experiments to achieve net power.** Link, H.F.; Parsons, B.K. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1986. Contract AC02-83CH10093. 8p. (CONF-860983—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010710.

From Oceans '86; Washington, DC, USA (23 Sep 1986).

Researchers at the Solar Energy Research Institute (SERI) conducted systems analysis studies to determine the potential of various experiments to produce net power using the Claude open-cycle ocean thermal energy conversion (OTEC) power system. The proposed experiment test site is to be the Natural Energy Laboratory of Hawaii at Keahole Point. We found that net power is unlikely to be produced in experiment sizes that use less than about 195 kg/s (3000 gpm) of cold water, and that flow rates of 420 kg/s (6500 gpm) are necessary to achieve a net-power production of at least one-half the gross-power output of the experiment.

45785 **Salinity driven oceanographic upwelling.** Johnson, D.H. (to Dept. of Energy, Washington, DC). US Patent 4,597,360. 1 Jul 1986. Filed date 30 Aug 1984. vp.

An upwelling device is described for mariculture comprising, a main duct having an elongated longitudinal wall portion, opposite end portions and a perforated cover plate at each opposite end portion, an interior space being defined in the main duct between the perforated cover plates, elongated flow segregating members supported in the interior space of the main duct and the flow segregating member having at least one end extending longitudinally beyond one of the perforated cover plates, a manifold plate for each end of the main duct, the manifold plate being spaced a predetermined amount from reapective the cover plates at each end portion of the main duct, at least one of the manifold plates accommodating a longitudinally extending end of the flow segregating members, the predetermined space between the manifold plate and a respective the cover plate defining respective fluid flow paths.

45786 **A seawater system study for a 10 MWe shore-based OTEC plant in the Hawaiian Islands.** Stevens, H.C.; Genens, L.E. (Argonne National Lab., Argonne, IL). pp 421-422 of Current practices and new technology in ocean engineering. McGuinness, T.; Shih, H.H. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860201—).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (23 Feb 1986).

OTEC seawater-resource systems studies are being made at ANL in support of the 5-15 MWe near-shore plant currently referenced in the DOE Multiyear Program Plan. The purpose of these ongoing studies is to provide an understanding of the cost structure of seawater systems using the most cost effective materials and design approaches available. Additionally, the study outlines major seawater systems problems and provides a basis for concentrating future R&D effort.

45787 **An update of an OTEC 10 MWe shore-based plant conceptual design.** Stevens, H.C.; Genens, L.E.; Panchal, C.B. (Argonne National Lab., Argonne, IL). pp 423-424 of Current practices and new technology in ocean engineering. McGuinness, T.; Shih, H.H. New York, NY; American Society of Mechanical Engineers (1986). (CONF-860201—).

From Energy-sources technology conference and exhibition; New Orleans, LA, USA (23 Feb 1986).

A second iteration and upgrade of a 10 MWe shore-based, closed-cycle OTEC plant design at Keahole Point, Hawaii, has been made reflecting improvements in some of the recent advances in technology and results of detailed studies. The primary thrust of the upgrade is to incorporate features which will improve the system efficiency and lower the capital cost. With the application of added detailed study, more conservatism in the design and its attendant cost estimates has been possible. A major innovative change in the design incorporates staging of the heat exchanger working fluid system which allows more efficient utilization of the cold and warm water resources. This feature, supplemented with detailed optimization codes, has produced a 10 MWe plant design with a substantially reduced seawater system capacity and a more compact plant with fewer seawater pumps, all consistent with a lower estimated capital cost.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 46032

45788 **(DOE/CS/30353—2) Security State Bank of Wells, Minnesota. Final technical report.** Weidt, J.L.; Hart, P.; Thorstenson, J. (Weidt (John) Associates, Inc., Minneapolis, MN (USA); Security State Bank, Wells, MN (USA); Hickey (Gene E.) and Associates, Inc., Edina, MN (USA)). 29 Jul 1986. Contract FC02-80CS30353. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014711.

The goal of this project was to design and predict the energy performance of a passive solar building, to build and monitor the building, and to compare its actual performance with that predicted. The project was a success from the point of view of the design team; the owner, the architect and the solar designer. It amply illustrated the benefits of passive solar design to commercial buildings, and it clarified areas within which further research will be beneficial.

45789 **(ERC-R—86020A) Open-cycle absorption solar cooling. Part I. Combined heat and mass transfer on an open flow liquid absorbent solar collector/regenerator. Final report.** Novak, K.S.; Wood, B.D.; Nelson, D.J. (Arizona State Univ., Tempe (USA). Solar Energy Lab.). May 1986. Contract AC03-84SF12223. 321p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86014455.

Previous collector/regenerator models have relied on established heat transfer correlations and the heat and mass transfer analogy to specify heat and mass transfer coefficients. These correlations were derived from relatively simple experiments and do not account for the complexities inherent in the collector/regenerator heat and mass transfer problem. This research was prompted by the need for a more accurate performance model based on experimentally determined combined heat and mass transfer correlations. Experimental data were taken on a prototype (11 x 11 m) collector/regenerator during the summer of 1984 in Tempe, Arizona. The data taken included local solution temperature measurements on the collector but only inlet and exit concentration measurements. A solution energy balance was solved iteratively to determine local concentrations and local heat and mass transfer coefficients. A new collector/regenerator model, based on the derived correlations, accurately predicted actual experimental temperature and concentration data. The model was used to test the effects of various climatic, operational and collector design variables on evaporation rate.

45790 **(ERC-R—86020B) Open-cycle absorption solar cooling. Part II. Heat and mass transfer analysis for glazed collector/regeneration. Final report.** Nelson, D.J.; Wood, B.D.; Collier, R.K. (Arizona State Univ., Tempe (USA). Solar Energy Lab.; Enerscope, Inc., Glendale, AZ (USA)). May 1986. Contract AC03-84SF12223. 261p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE86014456.

A two-dimensional analysis of steady laminar natural convection in an open ended parallel plate channel is presented for combined heat and mass transfer. Symmetric and asymmetric boundary conditions of uniform wall temperature and concentration (UWT/C) and uniform heat and mass flux (UH/MF) are considered for both aiding and opposing buoyancy due to mass transfer. The numerical method is then applied to model a glazed collector/regenerator component of an open-cycle solar absorption refrigeration system. The solution is coupled to an energy and mass balance on a thin film absorbent flow along one wall. The results indicate that the influence of glazing height is small if the flow is between the fully developed and single plate limits. The glazed collector/regenerator water evaporation rate is higher relative to the unglazed case because the reduction in convective and radiative heat losses increase the absorbent temperature and vapor pressure sufficiently to overcome the concomitant reduction in the mass transfer coefficient.

45791 **(ERC-R—86020C) Open-cycle absorption solar cooling. Part III. Evaluation of air-conditioning systems utilizing liquid absorbents regenerated by solar energy. Final report.** Siebe, D.A.; Wood, B.D.; Collier, R.K. (Arizona State Univ., Tempe (USA). Solar Energy Lab.; Enerscope, Inc., Glendale, AZ (USA)). May 1986. Contract AC03-84SF12223. 361p. NTIS, PC A16/MF A01; 1; GPO Dep. File Number DE86014457.

Previous open-cycle absorption modeling studies have been very limited and included only the solar collection part of the system. The purpose of this study was to evaluate the critical parameters necessary in order to have a viable system and to evaluate the potential for use of this type of system in various climatic regions of the United States. Thermodynamic property data were reviewed for several possible working solutions, analyzed to give predictive equations, and compiled into subprograms suited to system simulation work. The exergy concept was used to analyze the sources driving cooling systems. It was shown that an effectiveness based on exergy could be used as a thermodynamic common denominator to compare cooling systems using different driving sources, including those that utilize the evaporation of water to the atmosphere. Modeling of the absorber was used to show how an absorber, working with lithium chloride solution, would have to differ from an absorber, working with the lithium bromide solution used in conventional closed absorption-refrigeration equipment. System simulations were done for five system design concepts.

45792 **(ERC-R—86020D) Phase I, open-cycle absorption solar cooling. Part IV. Executive summary analysis and resolution of critical issues and recommendations for Phase II. Final report.** Wood, B.D. (Arizona State Univ., Tempe (USA). Solar Energy Lab.). Jun 1986. Contract AC03-84SF12223. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014458.

The objective of this project is to advance lower cost solar cooling technology with the feasibility analysis, design and evaluation of proof-of-concept open cycle solar cooling concepts. The work is divided into three phases, with planned completion of each phase before proceeding with the following phase: Phase I - performance/economic/environmental related analysis and exploratory studies; Phase II - design and construction of an experimental system, including evaluative testing; Phase III - extended system testing during operation and engineering modifications as required. For Phase I, analysis and resolution of critical issues were completed with the objective of developing design specifications for an improved prototype OCA system.

45793 **(SERI/TR—254-2841) Test results of immersed-coil heat exchangers and liquid storage tanks used in the packaged systems program.** Farrington, R.B. (Solar Energy Research Inst., Golden, CO (USA)). Jun 1986. Contract AC02-83CH10093. 70p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86010721.

The objective was to investigate the performance of and heat loss from laboratory prototypes of packaged active residential solar heating systems. The performance (effectiveness and overall heat transfer coefficient) of this type of heat exchanger varies with flow rate and the temperature difference between the storage tank and the inlet to the heat exchanger. This report discusses laboratory test results of the heat loss from three storage tanks and the performance of two immersed-coil heat exchangers. We tested a Honeywell domestic hot water heat exchanger that used a "collector-side" strategy, in which fluid is continually circulated through it to heat the storage tank, and a Trident heat exchanger that used a "load-side" strategy, in which fluid flows through the heat exchanger only on demand to meet the load. The collector-side heat exchanger performed very well at high temperature differentials and low flow rates. The load-side heat exchanger caused the tank to stratify with a very hot top layer that lagged behind the rest of the tank. We found that immersed heat exchangers perform better with reduced flow rates; that a load-side heat exchanger can be used with stratified storage tanks; and that both space heating storage tanks we tested failed under high-temperature conditions and had R-values much lower than expected.

45794 **Results of active solar control system testing and the performance effects of sensor degradation.** Farrington, R.B. (Thermal Systems and Engineering Branch, Solar Energy Research Inst., Golden, CO). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 157-169(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The Solar Energy Research Institute has been involved in testing control systems, including thermistors, switches, RTDs, integrated circuit sensors, and controllers, since 1981. The results show serious reliability problems with control systems. Sensors degraded or failed from exposure to high temperature, and controllers did not meet specifications. The effect of sensor degradation on annual performance has been quantified for a particular system configuration in four different locations; as much as 50% of the collected energy can be lost, and the auxiliary energy requirements can increase by 250%. Test results of three prototype control systems for solar space heating are also briefly discussed.

45795 **Long-time solutions to heat-conduction transients with time-dependent inputs.** Ceylan, H.T.; Meyers, G.E. (Univ. of Wisconsin, Madison). *Journal of Heat Transfer;* **102**: 111-116(Feb 1980). Contract AC03-80SF11508.

An economical method for obtaining long-time solutions to one, two, or three-dimensional heat-conduction transients with time-dependent forcing functions is presented. The conduction problem is spatially discretized by finite differences or by finite elements to obtain a system of first-order ordinary differential equations. The time-dependent input functions are each approximated by continuous, piecewise-linear functions each having the same uniform time interval. A set of response coefficients is generated by which a long-time solution can be carried out with a considerably lower cost than for conventional methods. The method has applications in problems of air-conditioning calculations for buildings and in the development of load models for solar energy studies.

1410 Solar Collectors And Concentrators

45796 **(CONF-860655—14) Pathways toward a low cost evacuated collector system.** Hull, J.R.; Schertz, W.W.; Allen, J.W.; O'Callagher, J.J.; Winston, R. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.). 1986. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014484.

From American Solar Energy Society annual meeting and 11. national passive solar conference; Boulder, CO, USA (8 Jun 1986).

The goal of widespread use of solar thermal collectors will only be achieved when they are proven to be economically superior to competing energy sources. Evacuated tubular collectors appear to have the potential to achieve this goal. An advanced evacuated collector using nonimaging concentration under development at the University of Chicago and Argonne can achieve a 50% seasonal efficiency at heat delivery temperatures in excess of 170°C. The same collector has an optical efficiency so that low temperature performance is also excellent. In this advanced collector design all of the critical components are enclosed in the vacuum, and the collector has an inherently long lifetime. The current cost of evacuated systems is too high, mainly because the volume of production has been too low to realize economies of mass production. It appears that certain design features of evacuated collectors can be changed (e.g., use of heat pipe absorbers) so as to introduce new system design and market strategy options that can reduce the balance of system cost.

45797 **(CONF-860655—15) Physical model of gradient zone erosion in thermohaline systems.** Hull, J.R.; Mehta, J.M. (Argonne National Lab., IL (USA); Illinois Inst. of Tech., Chicago (USA). Dept. of Mechanical Engineering). 1986. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014488.

From American Solar Energy Society annual meeting and 11. national passive solar conference; Boulder, CO, USA (8 Jun 1986).

A model is formulated for gradient zone erosion in thermohaline systems. The model includes effects at gradient zone boundaries of mildly turbulent thermals in adjacent convecting zones. The model predicts microconvection within the gradient zone, with an amplitude that decays exponentially away from the boundaries. The predicted thickness of observable disturbance agrees with observation. Applying the theory to stability of the boundary yields erosion behavior that agrees with an empirical correlation for boundary equilibrium.

45798 **(EPRI-AP—4608) Performance of the Vanguard Solar Dish-Stirling Engine Module. Final report.** Droher, J.J.; Squier, S.E. (Rockwell International Corp., Canoga Park, CA (USA). Energy Technology Engineering Center). Jul 1986. 224p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920415.

This report summarizes information on the performance of the Vanguard Parabolic Dish/Stirling Engine Module during an 18-month period of operational testing (February 1984 through July 1985) at Rancho Mirage, California. The test module consisted of a 10.7-m-diameter parabolic dish to collect and concentrate solar beam radiation, a solar receiver, a four-cylinder Stirling engine using hydrogen as the working gas, an induction generator, and an air-cooled radiator. Historical beam insolation data are summarized for the Palm Springs area. Gross and net output of electricity, auxiliary power requirements, system availability, and capacity factors are summarized on a monthly and annual basis. Models are presented for predicting electrical output. Operating and maintenance experience is delineated chronologically and by subsystem. The performance of each major subsystem is discussed. An assessment is made of the present and future status of the dish/Stirling system. Recommendations are made for future developmental work involving dish/Stirling applications for the utility industry.

45799 **(SERI/STR—253-2859) Wind load reduction for heliostats.** Peterka, J.A.; Hosoya, N.; Bienkiewicz, B.; Cermak, J.E. (Colorado State Univ., Fort Collins (USA)). May 1986. Contract AC02-83CH10093. 242p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE86010703.

This report presents the results of wind-tunnel tests supported through the Solar Energy Research Institute (SERI) by the Office of Solar Thermal Technology of the US Department of Energy as part of the SERI research effort on innovative concentrators. As gravity loads on drive mechanisms are reduced through stretched-membrane technology, the wind-load contribution of the required drive capacity increases in percentage. Reduction of wind loads can provide economy in support structure and heliostat drive. Wind-tunnel tests have been directed at finding methods to reduce wind loads on heliostats. The tests investigated primarily the mean forces, moments, and the possibility of measuring fluctuating forces in anticipation of reducing those forces. A significant increase in ability to predict heliostat wind loads and their reduction within a heliostat field was achieved.

45800 **(SERI/TP—255-2995) Effect of the size of structural bulk inhomogeneities on the specular transmittance of polymer films.** Neidlinger, H.H. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1986. Contract AC02-83CH10093. 8p. (CONF-860880—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010727.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

This paper will be confined to the effect of optical inhomogeneities in polymer films on the scattering or specular transmittance of light. Potential causes for the presence of scattering entities in the bulk phase of polymers will be discussed. It will be shown that practical transmittance measurements are greatly influenced by the angular width of the instrument receptor aperture. The choice of large receptor apertures will tend to include some of the scattering at small angles due to large inhomogeneities in the measurement of specular transmittance. As a consequence, the transmittance measured is not necessarily increased by reducing the size of the inhomogeneities in the polymer films, but there is a critical size when the specular transmittance is a minimum.

1420 Heat Storage

45801 **(DOE/SF/11936—T1) High-temperature composite thermal energy storage for solar applications. Draft. Final report.** Ong, E.T.; Petri, R.J.; Erickson, D.S. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1986. Contract AC03-83SF11936. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014161.

The objective of this program was to evaluate and screen concepts of applying direct-contact, sensible/latent heat storage media to the very high temperature regimes of high-efficiency solar power generation and solar chemicals/fuels and process heat.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

45802 **(LA—10634-MS) Geology of the platanares geothermal site, Departamento de Copan, Honduras, Central America. Field report.** Heiken, G.; Eppler, D.; Wohletz, K.; Flores, W.; Ramos, N.; Ritchie, A. (Los Alamos National Lab., NM (USA)). May 1986. Contract W-7405-ENG-36. 69p. (In Spanish and English). NTIS, PC A04/MF A01; GPO Dep. File Number DE86013629.

Platanares is located 16 km west of Santa Rosa de Copan, Honduras, along the Quebrada del Agua Caliente. The thermal manifestations are along faults in tuffs, tuffaceous sedimentary rocks, and lavas of the Padre Miguel Group. These tuffs are silicified near the faults, are fractured, and may provide the fracture permeability necessary for the hydrothermal system. Tuffs are overlain by a wedge of terrace gravels up to 60 m thick. Quaternary conglomerates of the Quebrada del Agua Caliente are cemented by silica sinter. The Platanares area contains numerous faults, all of which appear to be extensional. There are four groups of faults (N80°E to N70°W, N30° to 60°W, N40° to 65°E, and N00° to 05°W). All hot springs at this site are located along faults that trend mostly northwest and north. Twenty-eight spring groups were described over an area of 0.2 km^2; half were boiling. Based on surface temperatures and flow rates, between 0.7 and 1.0 MW thermal energy is estimated for the area. The increased temperature of the stream flowing through the thermal area indicates that several megawatts of thermal energy are being added to the stream. We recommend that a dipole-dipole resistivity line be run along the Quebrada del Agua Caliente to identify zones of fracture permeability associated with buried faults and hot water reservoirs within those fault zones. A thermal gradient corehole should be drilled at Platanares to test temperatures, lithologies, and permeability of the hydrothermal system.

45803 **(LA-UR—86-2009) Geothermal initiatives in Central America.** Hanold, R.J.; Loose, V.W.; Laughlin, A.W.; Wade, P.E. (Los Alamos National Lab., NM (USA); Air Force Academy, CO (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860926—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012374.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

The US Agency for International Development is supporting a new project in energy and resources exploitation for Central America. One of the largest components of the project involves exploration and reservoir development investigations directed at enhancing the production of electricity from the region's geothermal resources. An assessment of the geothermal resources of Honduras is in progress, and interesting geothermal regions in the Guanacaste Province of Costa Rica are being explored. Well-logging activities are in progress in the production wells at the Miravalles geothermal field in Costa Rica, and preparations are being made for logging critical wells at Ahuachapan in El Salvador. A self-contained logging truck, complete with high-temperature logging cable and logging tools designed for geothermal service, is being fabricated and will be made available for dedicated use throughout Central America. Geochemical and isotopic analyses of water samples collected in Panama are being evaluated to select a high-priority geothermal site in that country. Application of low- and medium-enthalpy geothermal fluids for industrial and agricultural processes is being investigated in Guatemala.

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 45802

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 45803

45804 **(LA-UR—86-1404) Hydrogeochemistry and preliminary reservoir model of the Platanares Geothermal System, Honduras, Central America.** Goff, F.; Shevenell, L.; Janik, C.J.; Truesdell, A.H.; Grigsby, C.O.; Paredes, R. (Los Alamos National Lab., NM (USA); Geological Survey, Menlo Park, CA (USA)). 1986. Contract W-7405-ENG-36. 7p. (CONF-860926—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010198.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

A detailed hydrogeochemical investigation has been performed at Platanares, Honduras in preparation for shallow geothermal exploration drilling. Platanares is not associated with any Quaternary volcanism but lies in a tectonic zone of late Tertiary to Quaternary extension. Thermal fluids are characterized by pH between 7 and 10, $Cl < 40$ mg/l, $HCO_3 > SO_4 > Cl$, $B \leq 17$ mg/l, $Li \leq 4$ mg/l and $As \leq 1.25$ mg/l. Various geochemical indicators show that mixing of hot and cold end-member fluids is an important hydrologic process at this site. Geothermometers indicate the geothermal system equilibrated at roughly 225°C while trace element chemistry indicates the reservoir resides in Cretaceous red beds of the Valle de Angeles Group. Based on the discharge rates of thermal features, the minimum power output of the Platanares geothermal site is about 45 MW (thermal).

45805 **(LBL—21727) Computerized data acquisition system for production, injection and interference tests.** Benson, S.M. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 10p. (CONF-860926—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013473.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

A computer-based system for collecting, processing, and analyzing pressure transient data has been developed. Primary components include downhole pressure sensors, linedrivers, a microcomputer, data storage disk, scanner, frequency counter, digital voltmeter, power supply, graphics plotter, and printer. In-field data processing and analysis greatly aid in handling the large volume of data that are collected during pressure transients tests, particularly the multiwell interference tests that are so important for characterizing and assessing geothermal reservoirs. In-field data processing provides the field engineer, on a real-time basis, with the information needed to make decisions regarding test parameters and duration. The system has been used on numerous occasions and has proved itself to be reliable under the harsh operating conditions that are usually encountered in the field. This paper describes the advantages of using this type of system for collecting data, the components and configuration of the system, and the software programs used to collect and process the data. Finally, two field applications are presented.

45806 **(SAND—86-1126C) Battery pack/controller for high temperature applications.** Wolfenbarger, F.M. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 6p. (CONF-860926—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011656.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

At temperatures in excess of 300°C, standard conductive wirelines cannot be used for signal or power transmission in geothermal wells. At such temperatures, a mechanical slickline can be used to raise and lower instrumentation, but the instrumentation control and power must then be self contained. This paper reviews the development of a battery and timing circuit to control a motor

in a Los Alamos National Laboratory sampling tool. The battery pack-controller circuitry enclosed in a dewar was used in the Salton Sea Scientific Drilling Project (SSSDP) for temperatures approaching 400°C.

45807 **(SAND—86-1127C) Development of downhole instruments for use in the Salton Sea Scientific Drilling Project.** Carson, C.C. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860926—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011421.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

Sandia developed high temperature logging instruments for use in the Salton Sea Scientific Drilling Project. These tools - Kuster mechanical tools for measuring temperature, pressure, and flow; a temperature and pressure tool built around an electronic memory; and a timing and control unit to power a downhole sampler - were all designed for slickline operation to temperatures up to 400°C. The drilling of the scientific well and the application of these tools in it were successful. The technology advances made in the development of these tools have been transferred to industry. These advances should prove valuable in future scientific and commercial applications.

1508 Geothermal Power Plants

45808 **(EGG-M—10286) Overview of recent supercritical binary geothermal cycle experiments from the Heat Cycle Research Program.** Demuth, O.J.; Bliem, C.J.; Mines, G.L.; Swank, W.D. (Idaho National Engineering Lab., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-860926—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011048.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

The Heat Cycle Research Program, which is being conducted for the Department of Energy, has as its objective the development of the technology for effecting improved utilization of moderate temperature geothermal resources. Testing at the Heat Cycle Research Facility located at the DOE Geothermal Test Facility East Mesa, California involves supercritical vaporization and counterflow in-tube condensing in an organic Rankine cycle. Results of the experiments are given for both pure and mixed-hydrocarbon working fluids. The heater and condenser behavior predicted by the Heat Transfer Research, Inc. computer codes used for correlation of the data was in excellent agreement with experimental results. A special series of tests, conducted with propane and up to approximately 40% isopentane concentration, indicated that a close approach to "integral" condensation was occurring in the vertically-oriented condenser. Preliminary results of tests in which the turbine expansion "passed through the two-phase region" did not indicate efficiency degradation assignable to these metastable expansion processes.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 45806, 45812

45809 **(SAND—86-1120C) Evaluating candidate lost circulation materials for geothermal drilling.** Loeppke, G. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-860926—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010999.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

Sandia National Laboratories' Geothermal Technology Development Division is working to advance the state of the art of lost circulation prevention and control. For this purpose, a large-scale lost Circulation Test Facility was designed and built. This paper addresses the evaluation of candidate lost circulation materisl using this facility and also using the recommended practice of API RP 131. Test results from these facilities are compared and discussed for the materials tested.

45810 **(SAND—86-1128C) Drilling fluid temperatures in a magma - penetrating wellbore.** Finger, J.T. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860926—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011184.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

This paper describes the numerical modeling of the drilling fluid temperatures in a deep well that penetrates a magma body. The basic assumptions for the model are listed, the importance of the fluid temperature is considered, and the effect of changing the model parameters is assessed. The stratigraphy and formation temperature profile assumed for this hypothetical well are similar to Long Valley, CA, where a relatively shallow magma body is believed to exist. A major result of this modeling is demonstration of the benefit of insulated drillpipe.

45811 **(SAND—86-2023C) Geochemistry and materials studies in support of the Magma Energy Extraction Program.** Westrich, H.R.; Weirick, L.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-860926—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010997.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

Geochemistry and materials studies are being performed in support of the Magma Energy Extraction Program. The scope of the studies is dictated by the sites under consideration and the designs of the drilling and energy extraction systems. The work has been largely restricted to characterizing magmatic environments at sites of interest and testing engineering materials in laboratory simulated rhyolite magmatic environments. The behavior of 17 commercially available materials has been examined at magmatic conditions. Analysis of reaction products reveal that oxidation, and not sulfidation, is the main corrosion problem for most alloys in rhyolite, and that reaction with other magmatic components is limited. Considerations of corrosion resistance, high-temperature strength, and cost indicate nickel-base superalloys offer the most promise as candidates for use in rhyolitic magma.

1520 Geothermal Data And Theory

45812 **(BNL—38019) Effects of carbon dioxide attack on geothermal cement grouts.** Milestone, N.B.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, NY (USA); Department of Scientific and Industrial Research, Petone (New Zealand). Chemistry Div.). Mar 1986. Contract AC02-76CH00016. 12p. (CONF-860926—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013919.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

Studies of carbonation of geotheirmal grouts have shown that the physical criteria recommended by the American Petroleum Institute do not apply for durability in CO_2-containing fluids. The high silica binders, normally considered desirable because of their high strengths and low permeability, become permeable when carbonated. This allows further attack on the grout, and if the fluids are undersaturated with $CaCO_3$, then rapid corrosion will occur. On the other hand, grouts which contain appreciable amounts of calcium hydroxide have proved the most durable in CO_2-containing fluids despite their low strengths and high permeability. This is due to an impermeable layer of calcium carbonate which forms on the outside of the sample preventing further penetration of reactant species. Unless this layer is corroded, no further attack occurs.

45813 **(DOE/SF/11682—T1) Model of gypsum, calcite and silica solubilities for application to geothermal waters over a wide range of temperature, P/sub CO_2/ and ionic strength. Final technical report, October 1, 1983-September 30, 1984.** (California Univ., Berkeley (USA)). 1984. Contract AT03-82SF11682. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014018.

This report describes the construction of a high temperature (25 to 250°C), variable P/sub CO_2/ (1 to 40 atm), chemical model of mineral (including gypsum, calcite and amorphous silica) solubi-

lities in the system: Na-K-Ca-H-Cl-SO_4-HCO_3-CO_3-CO_2-SiO_2-H_2O. This model was designed to support geothermal energy production needs.

45814 **Thermal expansion and cracking of three confined, water-saturated igneous rocks to 800°C.** Bauer, S.J.; Handin, J. (Texas A & M Univ., College Station). *Rock Mechanics and Rock Engineering;* 16: 181-198(1983). Contract AS05-79ER10361.

The thermal expansions of water-saturated Charcoal Granite, Mt. Hood Andesite, and Cuerbio Basalt were measured at effective confining pressures of 5, 50, and 100 MPa to 800°C. The mean coefficient of linear thermal expansion is a function of lithology, pressure, temperature, and initial porosity. The coefficient for the Charcoal Granite increases with temperature at all pressures. For the andesite at 5 MPa, it increases from 200 to 400°C, then decreases gradually to 800°C. At 50 MPa, the coefficient decreases slightly from 100 to 200°C, then increases at a low rate to 600°C. The basalt, however, has an essentially constant coefficient for temperatures less than 150°C at lower pressure and shows but a small increase from 100 to 800°C t 50 MPa. The difference between measured values of thermal expansion and those calculated from simple mixture-theory relates to new crack porosity generated as a result of differential thermal expansion at the anisotropic grain scale. For the granite, a two to three order of magnitude increase in permeability is predicted. The results have significance with respect to engineering problems of very deep drilling, geothermal energy production, and nuclear-waste isolation.

17 WIND ENERGY

1701 Availability (climatology)

45815 **(DOE/CH/10206—T1) Evaluating the impacts of an incomplete data set on estimating the wind power potential. Final report.** Baker, R.W.; Chu, P.S. (Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.). Sep 1984. Contract FG02-84CH10206. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011920.

To properly evaluate the wind power potential of a site an accurate and complete data set of preferably several years length are needed. Hourly wind speed and direction data are also preferred so a detailed analysis can be done of the important wind characteristics. However, collecting a complete hourly data set over a one year period is a formidable task. Maintaining and keeping wind sensors operational on an hourly basis are often difficult and as a result data records are often incomplete. Typically, on an annual basis data recovery is from 75 to 90%. The objective of this research is to evaluate the impact of missing data on the estimation of wind power resource statistics. These statistics include the monthly, seasonal, and annual mean wind speed, mean power density, and estimated wind turbine generator (WTG) energy output.

45816 **(NMRDI—2-73-4220) New Mexico anemometer loan program. Final report.** Stokes, K. (New Mexico State Univ., Las Cruces (USA). New Mexico Solar Energy Inst.). Jun 1986. 81p. NTIS, PC A05/MF A01 - NMERDI, Univ. of New Mexico, 457 Washington, S.E., Albuquerque, NM 87108. File Number DE86901583.

The New Mexico Solar Energy Institute has concluded monitoring 30 anemometer systems which were installed throughout the state. Wind resource data have been collected and analyzed for the period April 1985 through March 1986. The primary results are: average monthly and yearly wind speeds are reported for 28 sites where no wind record existed previously; two sites (Vado and Carrizozo) demonstrated a 12 mph average at a 30 foot tower height; and extrapolating annual wind speeds to 80 foot tower heights indicates nearly 12 mph averages are possible for seven additional sites (Las Cruces, Roy, Encino, Clovis, Springer, Carlsbad, and Vaughn).

1704 Economics

45817 **(DOE/BP/11191—9) Cape Blanco Wind Farm feasibility study. Technical Report No. 9. Socioeconomics.** Cunningham, E.S. (Envirosphere Co., Bellevue, WA (USA)). Apr 1986. Contract AC79-83BP11191. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86012860.

The socioeconomic impacts of a proposed wind farm at Cape Blanco, Oregon were assessed within the context of Curry County and, more specifically, Port Orford. The proposed 80-MW wind farm consists of installing either 455 units of FloWind 170-kW turbines or 31 units of Boeing MOD-2 turbines. Positive impacts are expected to occur during the on-year construction period. Local workers are expected to fill approximately 45 jobs for the Boeing alternative and 155 for the FloWind. The expenditures of nonlocal construction workers, estimated at $2.6 million (1984 dollars) for the Boeing and at $0.5 million (1984 dollars) for the FloWind, would contribute to increased revenues in the trade and services sectors of Port Orford. The construction workers for the FloWind alternative are expected to use primarily motels and trailer parks for their housing accommodations. Since there could be a shortage of temporary housing, particularly during the summer months, rental housing might need to be used. The demand for temporary housing, however, is not expected to displace tourists. If the Boeing alternative were selected, the construction contractor might need to provide worker housing to alleviate the demand for housing in Port Orford.

1705 Environmental Aspects

45818 **(DOE/BP/11191—8) Cape Blanco Wind Farm feasibility study. Technical Report No. 8. Land use.** Blair, W.G.E. (Jones and Jones, Seattle, WA (USA)). Apr 1986. Contract AC79-83BP11191. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86012911.

The land-use impacts of a proposed wind farm near Cape Blanco and Port Orford, Oregon, were assessed within the context of Curry County. Potential land-use impacts that could occur at other wind farm locations along the Oregon coast were also identified. The primary alternatives for the wind farm comprised (1) 31 Boeing MOD-2 horizontal-axis wind turbines and (2) 455 FloWind 170 vetical-axis wind turbines. A third alternative, consisting of 259 DAF 500 vetical-axis wind turbines was examined in less detail. As proposed, the construction of wind machine foundations and permanent gravel roads for the three alternative would lead to the irreversible loss of 29 to 57 acres of prime farmlands. These losses could be considerably reduced for the FlowWind and DAF alternatives by revising the proposed designs of the site access roads and the machine foundations. Because of the limited acreage involved, the author has judges the loss of prime farmlands not to be a significant adverse environmental impact in terms of the National Environmental Policy Act. An analysis of the impact of farmland conversion in terms of the Farmland Protection Policy Act will be made by the Soil Conservation Service (SCS), if and when a specific development plan for the wind farm is submitted to the agency. This analysis would be required if the wind farm would involve federal assistance other than permitting or licensing activities.

45819 **(DOE/BP/11191—10) Cape Blanco Wind Farm feasibility study. Technical Report No. 10. Cultural resources.** (USDOE Bonneville Power Administration, Portland, OR). Apr 1986. Contract AC79-83BP11191. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86012863.

The objective of the cultural resources study was to: (1) identify significant archeological and historic sites, cultural resources, within the area of the Cape Blanco Wind Farm's potential environmental impact; (2) identify potential impacts of the project on identified cultural resources; and (3) develop measures to mitigate or minimize impacts. Cultural properties discussed in the following sections of the cultural resources study were identified in the Port Orford Cultural Resources survey and Inventory (HSPP No. 8307), May 1984, and the National registor of Historic Places, and in consultation with the State Historic Preservation Officer. An intensive field survey of the project area was also conducted. Al-

though no cultural properties were identified during the field survey, several historic properties were located offsite that would be affected to varying degrees by the presence of generating machinery on the wind farm. Construction of neither of the transmission line alternatives would have an adverse effect on cultural properties because the line would not be visible from them.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 45818

45820 **(CERL-TPRD/L—2829/N85) Prediction of extreme offshore wind speeds at moderate elevations using upper-level wind data .** Moore, D.J.; Bennett, M. (Central Electricity Research Labs., Leatherhead (UK)). Aug 1985. 13p. British Library, Boston Spa, Wetherby, West Yorks .

In the design and operation of wind turbines, it is clearly of great economic importance to know accurately the frequency with which machines will be subject to severe winds. There are two aspects to the problem. The question of most importance is the speed of the strongest gust which is likely to be experienced over the design lifetime of the wind turbine. Secondly comes the problem of knowing the annual number of hours generation lost per year because conditions are too severe for safe generation. Both questions are examined in the light of radiosonde data from UK stations in the periods 1961-1970 and 1971-1980.

45821 **(DOE/NASA—0005-3) Application of a personal computer for the uncoupled vibration analysis of wind turbine blade and counterweight assemblies.** White, P.R.; Little, R.R. (Toledo Univ., OH (USA)). Dec 1985. Contract AI01-76ET20320. 143p. (NASA-CR—175090). NTIS, PC A07/MF A01. File Number TI86013617.

Section 2 of this report describes the theory used in calculating the natural frequencies and mode shapes. The theory is based upon a lumped mass formulation for the blade and counterweight assemblies. It is this theory which forms the basis for the development of the computer codes which ultimately generate the analytical results. Section 3 describes the computer codes developed and documents how the theory is implemented in the codes. The discussion of each code includes the input and output data structures used. The codes are designed to be as general as possible so that other designs can be readily analyzed. The input for the codes are generally interactive to facilitate usage. The actual code listings are included in the Appendix. Section 4 describes the operation and use of the computer codes. Section 4 also includes an example which demonstrates the application of the computer software. Section 5 describes the actual results of the analysis of the MOD-O blade and counterweight assemblies at various operational speeds and includes a discussion of the analytical and experimental results.

45822 **(DOE/R0/00484—T1) Port Townsend wind energy demonstration project. Project report.** Ross, L. (Port Townsend, City of, OR (USA)). 15 Dec 1984. Contract FG06-80R000484. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86012979.

A wind generator was used to demonstrate the use of wind energy on the campus of the Port Townsend High School. Through this project, enough data was collected to make a realistic evaluation of small wind projects. (BCS)

45823 **(DOE/R0/01242—T1) [Wind-powered generators. Final report].** Beck, W. (Beck (William), Pullman, WA (USA)). 15 Sep 1984. Contract FG06-81R001242. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013098.

This report is the result of the collection of data concerning the operation and economics of a wind electric generator at my home near Pullman, Washington. The wind velocity was monitored and recorded. This report contains information collected at two different sites and from both a 10kW utility interconnected wind electric generator and from a 1.8kW dc wind electric generator. This became necessary due to problems with the interconnection of the 10kW generator to my utility grid.

45824 **(DOE/RA/50664—1) Integration methodology for large wind-energy conversion systems. Final report.** Thomas, R.J. (Cornell Univ., Ithaca, NY (USA). School of Electrical Engineering). Jun 1986. Contract AC02-81RA50664. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86012872.

This report addresses a variety of problems associated with integrating large numbers of large wind turbine generators into an electric utility system. The report begins with statements of problem definition and background. We develop a technique for extrapolating a few spatial measurements (many measurements in time) to large numbers of spatially correlated time functions suitable for exercising individual and aggregate systems. An AC/DC/AC interface provides the most suitable mechanism for integration of large numbers of wind generating from the viewpoint of economics, steady-state and dynamic control, and protection. This leads naturally to the use of a variable-speed wind turbine. The interface can accommodate a fixed speed machine if there is reason to do so. We discuss the specific control system design for a variable-speed turbine and suggest a new variable speed generation mechanism, a controllable induction machine. The report then discusses the steady-state behavior of the wind farm in terms of control and scheduling of power flow, harmonics, and VAR requirements. A special wind farm load-flow program was developed for this study. Further study was performed from the power system point of view and in terms of voltage and VAR support requirements necessary to operate the farm. It is shown that with proper control the wind farm can enhance rather than degrade the system voltage profile. In addition, the same control mechamisms are useful for damping system transient oscillations caused by system disturbances. The last two chapters deal with wind farm protection and operation economics. It is shown in the final chapter that if the farm is properly operated that significant penetration can be achieved and that a marginal cost can be obtained that is consistent with economic dispatch.

45825 **(EPRI-AP—4528) Cost estimates for vertical-axis wind turbines. Final report.** Campbell, L.J.; Lessley, R.L. (Bechtel Group, Inc., San Francisco, CA (USA)). May 1986. 255p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920265.

Several conceptual designs of complete wind power plants were developed, and estimates of energy capture, capital cost, operating and maintenance cost, and cost of electricity were prepared. Two vertical-axis wind turbine designs were considered: the 500 kW DAF Indal Series 6400 and the 170 kW FloWind Model 170. Small cluster installations of 3.4 MW to 5.2 MW and large cluster installations of 85 MW to 130 MW were designed. The performance of each turbine was evaluated for four specific wind regimes, and the small and large cluster layouts were optimized for the baseline Amarillo, Texas, wind regime. Cost estimates were based upon existing production methods and capacities and upon higher production levels of 400 to 1000 units per year over a period of five years.

45826 **(EPRI-AP—4590) Testing requirements for variable-speed generating technology for wind turbine applications. Final report.** Herrera, J.I. (Electrotek Concepts, Inc., Knoxville, TN (USA)). May 1986. 56p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920321.

Guidelines for evaluating the impacts of integrating variable-speed, constant-frequency (VSCF) wind turbines into electric utility systems have been proposed based upon prior test experiences with the NASA VSCF system and the expected performance of the Westinghouse and OMNION VSCF systems. The NASA and Westinghouse VSCF generating systems use a wound rotor induction generator and a cycloconverter, while the OMNION system uses a wound rotor induction generator and a dc-current link converter. The design of VSCF/utility system interface requirements and test plans is based on utility system electrical issues such as utility system control and operation, protection, voltage/reactive power management, power quality, and reliability. A framework for testing VSCF concepts is proposed which includes a three stage process: modeling of the system to analyze design alternatives and simu-

late disturbances that could be harmful to the actual system; laboratory testing which involves the use of the system under controlled conditions; and field testing to collect data under actual conditions to validate models and analyze the wind turbine behavior.

45827 (EPRI-AP—4639) Wind power stations: 1985 performance and reliability. Final report. Lynette, R. (Lynette (R.) and Associates, Inc., Redmond, WA (USA)). Jun 1986. 108p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920351.

The use of wind power stations to generate electricity represents a new technology for the utility industry. Little is known about long-term energy production, equipment availability, and operation and maintenance costs. The objective of this report is to present the results of an assessment of field experience at a number of wind turbine sites. The data primarily covers 1985 field experience, but also includes previous years' experience when available. Operational information was collected and assessed from twelve commercial wind power stations and three experimental test sites. The data covers thirteen different wind turbine types. Results are presented for the current experience, and projections are developed for future large wind power stations.

45828 (PNL—5857) Model for simulating rotational data for wind turbine applications. Powell, D.C.; Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86010784.

This document describes a wind simulation model to be used in relation to wind turbine operations. The model is a computer code written in FORTRAN 77. The model simulates turbulence and mean wind effects as they are experienced at a rotating point on the blade of either a horizontal-axis wind turbine (HAWT) or a vertical-axis wind turbine (VAWT). The model is fast, requiring 15 to 120 seconds of VAX execution time to produce a simulation and related statistics. The model allows the user to set a number of wind parameters so that he may evaluate the uncertainty of model results as well as their typical values. When this capability is combined with short execution time, the user can quickly produce a number of simulations based on reasonable variation of input parameters and can use these simulations to obtain a range of wind turbine responses to the turbulence. This ability is important because some of the wind parameters that cannot be precisely evaluated should be prescribed over a range of values. This document is essentially a user's guide. Its features include theoretical derivations, samples of output, comparisons of measured and modeled results, a listing of the FORTRAN code, a glossary for the code, and the input and output of a sample run.

45829 (PNL—5903) Review of wind simulation methods for horizontal-axis wind turbine analysis. Powell, D.C.; Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1986. Contract AC06-76RL01830. 45p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86012223.

This report reviews three reports on simulation of winds for use in wind turbine fatigue analysis. The three reports are presumed to represent the state of the art. The Purdue and Sandia methods simulate correlated wind data at two points rotating as on the rotor of a horizontal-axis wind turbine. The PNL method at present simulates only one point, which rotates either as on a horizontal-axis wind turbine blade or as on a vertical-axis wind turbine blade. The spectra of simulated data are presented from the Sandia and PNL models under comparable input conditions, and the energy calculated in the rotational spikes in the spectra by the two models is compared. Although agreement between the two methods is not impressive at this time, improvement of the Sandia and PNL methods is recommended as the best way to advance the state of the art. Physical deficiencies of the models are cited in the report and technical recommendations are made for improvement. The report also reviews two general methods for simulating single-point data, called the harmonic method and the white noise method. The harmonic method, which is the basis of all three specific methods reviewed, is recommended over the white noise method in simulating winds for wind turbine analysis.

45830 (SERI/STR—217-2732) HAWT performance with dynamic stall. Hibbs, B.D. (AeroVironment, Inc., Monrovia, CA (USA)). Feb 1986. Contract AC02-83CH10093. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86004428.

In this report we calculated the effects of flow nonuniformities (wing shear, tower wake, yaw, and large-scale turbulence) on the performance of a horizontal axis wind turbine, accounting for dynamic stall. We modified the PROP program to incorporate and compare these effects with the uniform flow case. The MIT model, which predicts dynamic lift coefficients substantially higher than the static maximum values and includes a crude model of the vortex roll-off phenomenon, represented dynamic stall. As associated model for drag was also used. The dynamic stall model was tested against experimental data for three typical reduced frequencies. Good instantaneous correlation was obtained. The effects of nonuniformities with and without the dynamic stall were calculated using the Westinghouse Mod O and Enertech 44/25 turbines. Modeling the dynamic stall has little effect on performance. Furthermore, the performance with nonuniform flow differed only slightly from the uniform flow case. Thus the now PROP model provides a powerful general capability to handle nonuniform flows.

45831 (SERI/STR—217-2899) Feasibility of using wind power for an aerostat-borne radar system. Sklar, H. (Solar Energy Research Inst., Golden, CO (USA)). May 1986. Contract AC02-83CH10093. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86004461.

The feasibility of using a wind power system on an aerostat (tethered baloon) was studied. The system would be used by the US Air Force North Warning Program to provide power for a radar carried on the aerostat. Upper atmosphere wind data for a potential site were collected and probability functions for wind speed and wind power density calculated. Information was collected on aerostats, tethers, telemetry transmitters, and auxiliary equipment. Important design considerations were identified and useful mathematical expressions, e.g., wind reliability, derived. A first-cut wind power system was designed and system performance and aerodynamic loads were calculated. The benefits and risks of a wind power system were enumerated. The study concluded that a wind system is feasible for this application.

45832 Reactive power compensating system. Williams, T.J.; El-Sharkawi, M.A.; Venkata, S.S.; Butler, N.G. (to Dept. of Energy). US Patent Application 6-688,675. 4 Jan 1985. 93p. Contract AC79-80BP22849. DE86013776 NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86013776.

The circuit was designed for the specific application of wind-driven induction generators. It has great potential for application in any situation where a varying reactive power load is present, such as with induction motors or generators, or for transmission network compensation.

20 ELECTRIC POWER ENGINEERING

45833 (EPRI-EL—4522-Vol.1) Advanced power system security analysis concepts. Volume 1. A governor load flow modeling and simulation method. Final report. Schlueter, R.A.; Rusche, P.; Lotfalian, M.; Shu, L.; Yazdankhah, A.; Tedeschi, S.; Rhodes, R.; Idzior, D.; Whiting, D.; Sekerke, J. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Jul 1986. 84p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920422.

The research performed in project RP1999-1 addressed two tasks. The first task, presented in Volume 1, (a) developed a load flow method that simulates the generator governor response to a loss of generation contingency; (b) developed methods for obtaining accurate governor models for analyzing inertial and governor contingencies; and (c) compared the performance of inertial and governor load flow simulations with transient stability simulations and actual measurements. Comparisons of simulations and measurements used a 200 generator, 2300 bus model.

45834 **(EPRI-EL—4522-Vol.2) Advanced power system security analysis concepts. Volume 2. Security and stability assessment methodologies. Final report.** Schlueter, R.A.; Rusche, P.; Lotfalian, M.; Shu, L.; Yazdankhah, A.; Tedeschi, S.; Rhodes, R.; Idzior, D.; Whiting, D.; Sekerke, J. (Michigan State Univ., East Lansing (USA). Div. of Engineering Research). Jul 1986. 88p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920423.

Volume 2 presents the results of the second task of project RP 1999-1; the development of a stability/security assessment methodology. A methodology was developed and tested that identifies weak transmission boundaries that are vulnerable to loss of synchronism for loss of generation contingencies. A security/stability assessment method was also developed and tested that identifies and ranks critical contingencies, identifies and ranks weak boundaries, and assesses the relative level of security for a particular operating conditions. Applications of the methodology were also discussed.

45835 **(EPRI-EL—4729) Lightning flash characteristics.** Orville, R.E.; Henderson, R.W.; Pyle, R.B. (State Univ. of New York, Albany (USA). Dept. of Atmospheric Science). Aug 1986. 35p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920427.

A magnetic direction finding network for the detection of lightning cloud-to-ground strikes has been installed along the East Coast of the United States. Most of the lightning occurring from Maine to Florida and as far west as Ohio, Kentucky, and Alabame is detected. Time, location, flash polarity, stroke count, and magnetic field initial peak amplitude are recorded in real time. Flash locations, time, and polarity are displayed routinely for research and operational purposes. The data are being compiled into a data base to provide statistical information necassary for the prediction of the surge performance of electric power lines and the improvement of surge protection practices. Preliminary results are presented in this report.

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 45639, 45759, 45881, 45882, 45993, 46133, 46134

45836 **(EPRI-EM—4643) International load management conference: proceedings.** Limaye, D. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Jun 1986. 814p. (CONF-851215—). Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920370.

From International load management conference and exposition; Chicago, IL, USA (9 Dec 1985).

High capital costs of new generating capacity, uncertain load growth, and poor load factors represent important challenges to the electricity industry. Load management provides some of the tools to meet these challenges. This conference focused on the performance and cost of load management technologies and on utility experiences in testing and implementing the equipment.

45837 **(EPRI-P—4542) Capital cost estimates and schedules for coal-fired power plants. Final report.** Van Slambrook, R.T. (Bechtel Group, Inc., San Francisco, CA (USA)). Aug 1986. 178p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920437.

Conceptual designs and order-of-magnitude capital cost estimates, including expenditure schedules, have been prepared for conventional 330 MW and 500 MW pulverized coal-fired power plants located in Kenosha, Wisconsin, near an urban center, and Hermiston, Oregon, in a remote location. The plants have been designed and estimated for burning low-sulfur subbituminous Wyoming coal. The capital cost estimates are at end-of-year 1984 price level with no escalation and are based on the contractor's current construction projects and vendor pricing. Conservative estimating parameters, based on EPRI reports PE-1865 and P-2410-SR, have been used to ensure their suitability as planning tools for utility companies. The estimated total capital requirements range from $1,220 /kW for twin-500 MW units at Kenosha to $1,830/kW for a single-330 MW unit at Hermiston. Summary engineering/procurement/construction site-specific schedules are presented and reflect current industry trends for design, fabrication, delivery and erection of major plant components and differences in bulk material quantities. Accelerated schedules were developed to incorporate changes in procudures and/or practices that will shorten construction time, and the cost impacts and feasibility were assessed. Estimated of manual labor requirements and labor curves were also prepared. Findings show that a replicated plant built on Rolling 4 x 10's (70 hour workweek) would offer the shortest project schedule and be a superior choice if captial cost were the primary consideration. An overall schedule shortening of about four months would be achieved and corresponding reduction of $45 million or three percent of total capital requirements. An assessment of the effects of ten cases of deferral and/or cancellation ranging from six months before site work starts to two years after site work starts when engineering or construction is already in progress was performed. 12 refs., 41 figs., 37 tabs.

45838 **(PB—86-202298/XAB) Rotary pump seals in 2000 MW power stations.** Flitney, R.K. (British Hydromechanics Research Association, Cranfield). 1983. 10p. (TN—1991). NTIS, PC A03/MF A01.

Visits were undertaken to two 2000-MW coal-fired power stations, Eggborough and Ratcliffe. The pumping applications were discussed with the engineering staff of the stations with particular emphasis on the sealing systems employed, their reliability and the improvements the stations would like to see in these areas. The report summarizes the application areas and indentifies those where an increase in seal reliability would provide an operational advantage to the C.E.G.B.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 45629

2003 Power Transmission And Distribution

45839 **(CONF-8609118—1) High voltage direct current research program.** Long, W.; Gnadt, P.A. (Oak Ridge National Lab., TN (USA); Wisconsin Univ., Madison (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013253.

From C.I.G.R.E. meeting; Paris, France (4 Sep 1986).

In 1984, a long-range program plan was prepared by the Oak Ridge National Laboratory (ORNL) for the Department of Energy Electric Energy Systems program (DOE/EES) on research and development of high voltage direct current (HVDC) power systems and components. The overall goal of the program is to provide electric system planners with HVDC technical options that may be compared with the high-voltage alternating current (HVAC) choices when designing or modifying power systems. Specific research objectives are to develop a fundamental understanding of dc/ac system interactions and economics, determine bulk power transfer options, investigate dc power delivery within high-density load areas, and develop dc components and systems.

45840 **(DOE/BP—555) Bonneville Power Administration's technical career program for professional engineers (TCPPE) gas-insulated substations (GIS) seminar: proceedings.** (USDOE Bonneville Power Administration, Portland, OR). Jun 1986. 83p. (CONF-8505294—). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86012884.

From 3. annual seminar of the technical career program for profesional engineers; Portland, OR, USA (10 May 1985).

The seminar concentrated on gas-insulated substations. Eight papers are included. (DLC)

45841 **(DOE/ET/29201—T1) Surge arresters for 1200-kV gas-insulated substation. Final report.** Connell, T.R.; Kalb, J.W. (Ohio Brass Co., Wadsworth (USA). Frank B. Black Research Center). Oct 1983. Contract AC01-76ET29201. 144p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86012297.

With the exception of dynamic overvoltage performance at 1.4 pu, the electrical requirements were met. The design offers a 20% improvement in protective levels and is 60% smaller than con-

ventional designs for gas-insulated substations. It is uniquely to the coaxial geometry of gas-insulated substations. It requires no special manufacturing or assembly techniques. The design is suitable for dc use. A current limiting gap design of essentially the same geometry would apparently meet the requirements but would be less durable, likely not less costly and is probably no longer commercially acceptable.

45842 (EPRI-EL—4388) Development of an SF_6 high-voltage dc circuit breaker. Final report. Yoon, K.H. (Westinghouse Electric Corp., Trafford, PA (USA). Power Equipment Div.). Jul 1986. 110p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920424.

In a field trial on the West Coast high-voltage dc intertie, a circuit breaker designed much like an ac puffer breaker commutated currents of up to 1200 A. With minor modifications, devices based on this design should be able to handle 2200 A at 500 kV, thus increasing utility flexibility in operating dc systems.

45843 (ORNL/Sub—80-7979) Research on factors that affect the reliability of compressed gas insulated apparatus. Final report. Cook, C.M.; Liu, Z.; Rynkowski, A.; Saito, K. (Massachusetts Inst. of Tech., Cambridge (USA). High Voltage Research Lab.). Jul 1986. Contract AC05-84OR21400. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86014417.

The reliability of compressed gas insulated apparatus (GIS) is determined by the electrical stresses in the system in relation to inherent strengths of the materials used. Models for gas insulation failure were developed and verified experimentally. Failure was the result of a two-stage process which involves initiation and then propagation sufficient to bridge the high voltage gap. Emphasis was placed on control of parameters and processes so that critical conditions for low voltage, low probability failures could be determined. A probability model for initiation considers the micro-irregularities on electrode surfaces and establishes breakdown probabilities calculating the likelihood of sufficient ionization to meet the streamer criteria. The probability analysis was used to model time to breakdown, electrode area effect, and pressure effect. Studies were made of breakdown initiated by electrode irregularities and metallic particles in the gas and along insulator surfaces. The initiation of flashovers was studied. The role of single particle and multiple controlled particles, showed the main sensitivity to be due to the maximum size field enhancement. The studies on insulator surfaces also included substantial modelling. Static charge transport was carefully investigated and reproducible and consistent results obtained. One conclusion is that electrode surfaces near insulators can greatly affect performance. Major advances in the understanding and prediction of low-probability failures were made as a result of this project. Recommendations concerning the improvement and monitoring of reliability of GIS were made.

45844 (ORNL/TM—9596) Athens automation and control experiment: substation and distribution system automation designs and costs. Purucker, S.L.; Thomas, R.J.; Fortson, N.H.; Monteen, L.D. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014421.

The Athens Automation and Control Experiment (AACE) is a hardware- and software-oriented research and development project installed on the Athens Utilities Board's distribution system in Athens, Tenessee. Purposes are to automate the distribution system and to develop and implement control strategies that improve the efficiency and controllability of the power system. This report documents the automation designs and costs. The basic monitoring and control instrumentation system is discussed to show how the parameters of a 13-kV distribution system are measured. The telecommunication techniques used for transmittal of field data to the central control computer and for control signal transmission to the distribution equipment are explained. The installation designs for the hardware used on an automated distribution feeder are presented. Four basic types of automated distribution feeder designs are discussed: load-break switch, power recloser, voltage regulator, and capacitor. The equipment installed in customers' residences for monitoring and controlling load is also described. The appendices to this report include the substation and distribution feeder single-line diagrams showing the location of the automation equipment, a tabulation of the functional requirements of the various types of remote terminal unit installations, the standard design drawings for the pole-mounted equipment, equipment specification data sheets, and material costs and labor required for each type of installation.

21 NUCLEAR POWER PLANTS

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 45889, 45901, 45908, 45909, 45910, 45911, 45912, 45913, 45914, 45915, 45916, 45917, 45918, 45919, 45920, 45923, 45930, 45932, 45935, 45936, 45938, 45939, 45940, 45941, 45944, 45945, 45946, 45947, 45949, 45951, 45954, 45957, 45959

45845 (HEDL—7591) Trend curve data development and testing. McElroy, W.N.; Gold, R.; Simons, R.L.; Roberts, J.H. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76FF02170. 82p. NTIS, PC A05/MF A01 - GPO. File Number TI86014374.

Existing trend curves do not account for previous and more recently observed test and power reactor flux-level, thermal neutron and gamma-ray field-induced effects. Any agreement between measured data and trend curve predictions that does not adequately represent the important neutron environmental and temperature effects as well as the microstructural damage processes, therefore, could be fortuitous. Two principal questions asked concerning the metallurgical condition of the pressure vessel and its support structures are: What are the controlling variables; and What effects do they have on changing the metallurgical properties of the vessel and its support structures throughout their lifetimes.

45846 (NUREG—1202) Technical Specifications, Hope Creek Generating Station (Docket No. 50-354). Appendix "A" to License No. NPF-57. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1986. 513p. NTIS, PC A22/MF A01 - GPO. File Number TI86901612.

Information is presented concerning: safety limits and limiting safety settings; limiting conditions for operation and surveillance requirements; design features; and administrative controls for the Hope Creek Generating Station.

45847 (NUREG/CR—4367-Rev.1) ORVIRT.PC (Version 2.0): a 2-D finite-element fracture analysis program for a microcomputer. Revision 1. Bryson, J.W. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 68p. (ORNL—6208/R1). NTIS, PC A04/MF A01 - GPO. File Number TI86014238.

ORVIRT.PC (Oak Ridge VIRTual crack extension. Personal Computer) is a two-dimensional (2-D) finite-element fracture analysis program for an IBM PC/AT or PC/XT microcomputer. The code is based primarily on the techniques used in the ORMGEN-ADINA-ORVIRT fracture analysis system. ORVIRT.PC is a stand-alone program capable of performing 2-D linear-elastic stress and fracture-mechanics analyses. The present version (2.0) has been upgraded to include axisymmetric analysis capability. Thermal loadings may be analyzed in addition to mechanical loadings. Crack-face tractions may also be considered. Eight-noded isoparametric elements that combine both performance and ease of modeling are employed in the program. Special crack-tip elements that allow for an inverse square root variation in the near tip stress and strain fields may be used at the crack tip. Detailed user instructions describe both preparation of input data and program operation. Sample problems are presented that demonstrate good agreement with known solutions. 14 figs.

45848 (NUREG/CR—4503-Vol.1) Long-term embrittlement of cast duplex stainless steels in LWR systems. Annual report, October 1984-September 1985. Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL (USA)). Jan 1986. Contract W-31-109-ENG-38. 38p. (ANL—86-3-Vol.1). NTIS, PC A03/MF A01 - GPO. File Number TI86007561.

This progress report summarizes work performed by Argonne National Laboratory on long-term embrittlement of cast duplex stainless steels in LWR systems during the 12 months from October 1984 to September 1985. 15 refs., 17 figs.

45849 **Reactor shutdown experience.** Kimmins, A.D.C. (comp.). *Nuclear Safety;* 27: No. 1, 85-86(Jan-Mar 1986).

This section presents a regular report of summary statistics relating to recent reactor shutdown experience. The information includes both numbers of events and rates of occurrence. The information was compiled from data about operating events entered into the RECON data system by Nuclear Operations Analysis Center at the Oak Ridge National Laboratory, covering the three-month period of the third quarter of 1985. Cumulative information, since May 1, 1984, is also shown. Updates on shutdown events included in earlier reports are excluded.

45850 **Comparative steady-state and power-ramping performance of annular-coated-pressurized, sphere-pac and reference test rods in the Halden BWR.** Crouthamel, C.E.; Woods, K.N.; Barner, J.O. (Exxon Nuclear Co., Inc., Richland, WA, USA; Battelle Pacific Northwest Labs., Richland, WA, USA). *Res Mechanica;* 17: No. 3, 193-219(1986).

Instrumented fuel rods were irradiated and power-ramp tested in the Halden Boiling Water Reactor under the Fuel Performance Improvement Program. The fuel rods were irradiated to burnup levels up to 16 MWd kgM^{-1} at linear heat generation rates of up to approx. 40kWm^{-1}. After these base irradiations, the fuel rods were power ramped to terminal powers in the 66-74 kW m^{-1} range. The types of fuel rod instrumentation included cladding elongation monitors, internal rod pressure sensors, and fuel centerline thermocouples. None of the fuel rods failed during the base irradiation or power-ramping tests. This paper summarizes the measurements performed during these irradiation tests and discusses the specific irradiation behaviour of each fuel design concept.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 45845, 45847, 45848, 45849, 45889, 45899, 45900, 45901, 45908, 45909, 45910, 45911, 45912, 45913, 45914, 45915, 45916, 45917, 45918, 45919, 45920, 45923, 45929, 45930, 45931, 45932, 45933, 45934, 45935, 45936, 45938, 45939, 45940, 45941, 45942, 45943, 45949, 45952, 45953, 45955, 45957, 45959, 46121, 46130, 46144, 46662, 46682

45851 **(EPRI-NP—4550) Condensate polishers for brackish water-cooled PWRs.** Sadler, M.A.; Darvill, M.R.; Bickerstaffe, J.A.; Chakravorti, R.; Siegwarth, D.P. (Central Electricity Generating Board, Bristol (UK). Scientific Services Dept.; Gibbs and Hill, Inc., San Jose, CA (USA); NWT Corp., San Jose, CA (USA)). Jul 1986. 204p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920433.

The objectives of project RP 1571-5 "Optimization of Pressurized Water Reactor Secondary Water Treatment: Task 4 Conceptual Design Options - Condensate Polishing" were to provide detailed guidelines for the design of a condensate polishing system for retrofitting to a seawater cooled PWR. For this purpose a national 1100MW PWR with recirculating steam generators was defined. The polished water to be produced by this plant must be of such a quality so as to permit the advisory SGOG guidelines on impurity levels in Steam Generator water to be achieved. Target maximum impurity levels in the final polished water were proposed by the RP 1571 Project review Team and adopted for this study.

45852 **(EPRI-NP—4551) Condenser improvements for PWRs.** Bacharier, J.; Chakravoti, R.K.; Siegwarth, D.P.; Kassen, W.R. (Gibbs and Hill, Inc., San Jose, CA (USA); NWT Corp., San Jose, CA (USA)). Aug 1986. 40p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920436.

Steam generators and turbines in pressurized water reactor plants have experienced a variety of corrosion problems as a result of ionic, corrosion product and oxidizing species transport into the steam generators. Turbine condenser modifications which will minimize cooling water and air inleakage, and improve reliability are specified for a 1160 MWe design basis plant. Cost estimates for instituting the modifications, and changes in operating and maintenance costs as a result of the modifications are given.

45853 **(EPRI-NP—4648) Effects of oxygen, copper and acid chlorides on denting corrosion.** Mann, G.M.W.; Castle, R. (Central Electricity Research Labs., Leatherhead (UK)). Jul 1986. 51p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920406.

The effect of dissolved oxygen and copper on denting corrosion at 280°C in solutions of NaCl at pH 9 with ammonia was investigated using a packed tube/support plate crevice in a laboratory simulation. The onset of corrosion was detected with a hydrogen analyzer sensitive to 0.2 ppB. In the absence of copper, rapidly rising hydrogen concentrations were detected only when the product of the chloride and oxygen concentrations were detected only when the product of the chloride and oxygen concentrations in the boiler-water exceeded 25 $(ppM)^2$, but at these high concentrations, unheated low-carbon steel surfaces in the system were as sensitive to corrosion as the heated crevice. When copper metal was present in the feed system, corrosion of the heated crevice occurred in the absence of oxygen, provided the copper had previously been exposed to dissolved oxygen. Dosing hydrazine into the feedwater eventually suppressed the ability of copper to initiate corrosion. It is proposed that copper ions are more efficient than oxygen in promoting corrosion within the crevice because unlike oxygen thay are carried into the crevice during boiling. Corrosion results from the anodic formation of acidic solutions in the crevice as a result of the cathodic reduction of oxidized copper species. 20 figs.

45854 **(EPRI-NP—4698) Industrywide survey of PWR organics. Final report.** Richards, J.E.; Byers, W.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.). Jul 1986. 260p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920434.

Thirteen Pressurized Water reactor (PWR) secondary cycles were sampled for organic acids, total organic carbon, and inorganic anions. The distribution and removal of organics in a makeup water treatment system were investigted at an additional plant. TOC analyses were used for the analysis of makeup water systems; anion ion chromatography and ion exclusion chromatography were used for the analysis of secondary water systems. Additional information on plant operation and water chemistry was collected in a survey. The analytical and survey data were compared and correlations made.

45855 (INIS-mf—10145, pp 145-152) **Effect of technological design of tube-tubeplate joint of WWER steam generator on resistance to long-term stress in operating conditions.** Riha, Z.; Lichy, J. (Vitkovicke Zelezarny Klementa Gottwalda, Ostrava, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The technology of fitting tubes in collectors consists of two procedures: a front weld production between the end of the heat exchange tube and the opening of the tubeplate, and fixing the tube along the whole length of the opening in the tubeplate. In the WWER 440 steam generator, heat exchange tubes 16x1.4 mm in diameter from steel 08Cr18Ni10Ti are joined to tubeplates from the same steel in a thickness of 136 mm with openings 16.25 mm in dia. The technologies are discussed of hydraulic and explosion fixing. The latter takes 2 - 3 μs and the tube wall connects with the tubeplate at 150 $m.s^{-1}$. Following cyclic temperature stress the explosion-connected joints loosen and corrode. Surface explosion welding requires accurate configuration of joints with a gap size of ca. 0.7 mm and an explosive inducing the minimum tube impingement rate of 400 $m.s^{-1}$ at maximum cleanness of surfaces. These explosion welds are resistant to loosening. However, they must be tested for susceptibility to corrosion cracking. Hydraulic fixing is carried out by plastic deformation of the tube with a high pressure liquid. The joints are again susceptible to loosening. Further experiments to test the long-term properties of joints are being prepared by VUHZ Dobra.

45856 **NRC licensing of Diablo Canyon. Hearing before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce, House of Representatives, Ninety-Ninth Congress, First Session, July 10, 1985.** Washington, DC; Government Printing Office (1986). 326p.

The members of the Nuclear Regulatory Commission (NRC) and two California members of Congress testified at a hearing to examine the decision-making capacity and the integrity of the NRC. The specific issue was whether the issuance of an operating license to the Diablo Canyon nuclear plant violated the Atomic Energy Act in the area of safety. The transcripts of closed meetings of the NRC and the expression of concern by California congressmen and a member of the NRC about the Commission's decision-making process prompted the hearings. Specific concerns were the possible avoidance of a public hearing on emergency plans in the event of an earthquake and to avoid the costs of a hearing and the quality of information used as a basis for the decision. Each member of the Commission testified in response to these concerns. The California representatives noted that Commissioners did not follow legal advice, and that they relied upon second-hand information. Other material and documents submitted for the record follows the testimony.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 45872, 45959, 45961

45857 **(BNL—38379) Compact nuclear power systems based on particle bed reactors.** Horn, F.L.; Powell, J.R.; Steinberg, M.; Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 10p. (CONF-860601—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014169.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

Compact, low cost nuclear power systems with an extremely low radioactive inventory are described. These systems use the Particle Bed Reactor (PBR), in which HTGR particle fuel is contained in packed beds that are changed daily. The small diameter particle fuel (500 μm) is directly cooled utilizing the large heat transfer area available (7.8 m^2/liter), thus allowing high bed power densities (MW/liter).

45858 **(JAERI-M—85-054) Inclining test for the bottom-core structure of VHTR.** Futakawa, Masatoshi; Kikuchi, Kenji. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1985. 22p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE86703192.

The change of acting forces on the core restrainers is studied by inclining a small-scale bottom-core structure model of VHTR. The forces produced by the inclination of the model simulate the horizontal seismic static forces. The behavior of the bottom-core structure was also analysed by using a simplified sliding-block model. The estimated apparent friction coefficients of both graphite against itself and graphite against steel are compared with the results obtained by means of a friction coefficient measuring apparatus and discussed. The conclusions derived are as follows: (1) The change of acting forces on the core restrainers die not reduce to zero after the inclining test. (2) The apparent friction coefficients were estimated to be 0.10 for graphite against itself and 0.19 for graphite against steel at the atmospheric environment.

45859 **(NUREG/CR—4526) Finite element analysis of the 2240 MW HTGR PCRV.** Fugelso, L.E. (Los Alamos National Lab., NM (USA)). Apr 1986. Contract W-7405-ENG-36. 40p. (LA—10663-MS). NTIS, PC A03/MF A01 - GPO. File Number TI86010876.

Three-dimensional finite element calculations for the response of the prestressed concrete reactor vessel for the 2240 MW HTGR which evaluated the stress distributions and concentrations were accomplished. Constitutive equations utilized in this evaluation were linear elastic, Von Mises elastic-plastic and the empirical Kotsovos-Newman concrete fit with and without steel reinforcing. Ultimate values of the internal pressures without initial prestress were obtained. Also stresses in the annular concrete retaining cover over the stream generator were evaluated.

45860 **Regulatory policy for advanced nuclear reactors. Hearing before the Subcommittee on Energy Research and Production of the Committee on Science and Technology, US House of Representatives, Ninety-Ninth Congress, First Session, October 31, 1985.** Washington, DC; Government Printing Office (1986). 101p.

Three members of the Nuclear Regulatory Commission (NRC), scientists, and representatives and analysts of the nuclear power industry testified on the NRC's plans for regulating the licensing of advanced reactors in order to protect the environment and ensure safety. Performance standards for manufacturers are the next step after investing dollars in advanced reactor research. NRC Chairman Nunzio Palladino outlined NRC's goals in developing a regulatory policy for new reactor designs that will stress standardization. Other witnesses described the reactive nature of past NRC regulation and the tendency to let cost considerations predominate, the importance of advanced reactor technology to supply electric power in the future, and the need to improve definitions in regulatory policy. Additional material submitted for the record follows the testimony of the seven witnesses.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 45860, 45900, 45904, 45915, 45921, 45927, 45928, 45937, 45958, 45959, 45960, 46144, 47002

45861 **(CONF-860501—14) FPIN2 code: an application of the finite element method to the analysis of the transient response of oxide and metal fuel elements.** Hughes, T.H.; Kramer, J.M. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014493.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

The FPIN2 code simulates the thermal-mechanical response of fast reactor fuel pins to transient events. Temperatures of the fuel pin and coolant are calculated using a simple pin-in-a-pipe geometry. The mechanical analysis uses an implicit finite element formulation with linear shape functions which allow for general material behavior in the fuel and cladding including cracking and melting. This formulation provides a very convenient structure for implementing different models and improvements in algorithms. The paper summarizes the FPIN2 methodology and presents results for the transient response of both oxide and metallic fuel pins under similar overpower transients.

45862 **(INDC(CCP)—251/L) Measurement and evaluation of nuclear data for fissile and fertile isotopes: An important task of present-day physics.** Van'kov, A.A. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703179.

This paper considers questions relating to the analysis of neutron cross-section measurements and measurements of transmission functions for heavy isotopes in the unresolved resonance region. It also considers questions connected with the evaluation of group constants. Conclusions are drawn regarding the need to set up new experiments for measuring transmission functions. Translated from Russian. 16 refs.

45863 **(INIS-mf—10145, pp 55-61) Evaluation of structural materials used for manufacture of BOR-1 steam generator.** Sima, A.; Houska, S.; Kostal, M. (Vyzkumny Ustav Energetickych Zarizeni, Brno, Czechoslovakia; Prvni Brnenska Strojirna, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The first Czechoslovak experimental modular steam generator, the 30 MW BOR-1, was manufactured in Czechoslovakia in 1973 and was put into trial operation at the BOR-60 nuclear power plant in Dimitrovgrad in the USSR. The steam generator was designed as a tri-metallic system. The casing tubes of the superheater were made of austenitic steel of the DIN 1.4306 type designated as 3R12. The heat exchange tubes in the superheater were made of high alloy material of the DIN 1.4876 type designated as SANICRO 31. The modules of the evaporator and the economizer were made of low-alloy ferritic-perlitic Nb-stabilized steel of the DIN 1.6770 type designated as HT8X6. In 1979, small and large leakages of the steam generator were simulated by injecting steam into sodium. After termination of the experiment the materials were subjected to metallographic investigation. In the 3R12 material long-term operation had not caused any substantial changes with the exception of precipitation of carbides at the grain boundaries under the surface. The SANICRO 31 material showed a negligible increase in strength and reduction in plastic properties. At the inlet of sodium into the superheater where the highest temperature is recorded the material showed a susceptibility to intergranular corrosion. The HT8X6 did not show any substantial changes in mechanical properties. On the inner surface of the tubes on the water side a layer of corrosion products and deposits was found up to 0.3 mm in thickness. In some places corrosion in form of pits and small cracks to a depth of 0.2 mm was found under the deposits.

45864 (INIS-mf—10145, pp 62-70) **Corrosion resistance in liquid sodium and residual life after 40,000-hour exploitation of structural materials used for BOR-1 steam generator.** Fresl, M.; Eremias, B.; Rosypal, J.; Rozumbersky, A. (Statni Vyzkumny Ustav Ochrany Materialu G.V. Akimova, Prague, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

A 40,000-hour corrosion test was carried out of structural materials on the 30 MW BOR-1 steam generator in Dimitrovgrad in the USSR. Tested in liquid sodium were the following structural materials: HT8X6 (Cr2.25Mo1Nb), 3R12 (Cr18Ni11) and S31 (Cr20Ni35Ti). The materials preserved their good mechanical properties, including unchanged structures of welded joints. Changes in carbon concentration were studied by gradual sampling of successive layers 25 μm in thickness. Carburization of all used materials was only found to have taken place in surface layers to a depth of 100-150 μm. Tests of intergranular corrosion only showed sensitization in S31 tubes, this most pronounced at the sodium inlet to the superheater, i.e., at 480 degC. A 10,000-hour corrosion experiment was made in liquid sodium at a temperature of 550 degC under conditions of convection flow. The test showed that uniform corrosion due to sodium does not affect the planned service life of used structural materials. Structural changes of the materials are described resulting from exposure to corrosion in the BOR-1 steam generator. Possible uses of HT8X6 and 3R12 for fast reactor steam generators are discussed.

45865 (INIS-mf—10145, pp 80-88) **Thermodynamics of material properties degradation in fast reactor steam generator under effect of liquid sodium.** Walder, V. (Vyzkumny Ustav Hutnictvi Zeleza, Dobra, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The possibility is discussed of a quantitative approach to the evaluation of changes in Nb-stabilized low alloy steel due to the effect of liquid sodium. The numerical finite difference method was applied to diffusion processes using the variability of all thermodynamic values entering the calculation. At thermodynamic balance with existing carbides, it will be possible to take into account the temperature gradient, the effect of the size of carbides and the effect of applied strain. The fact that the diffusion coefficient of carbide-forming niobium is by seven orders lower than that of carbon led to the use of the model of quasi-steady state diffusion. The dissolution of carbides and the diffusion of both elements is studied and the activities are investigated of carbon and niobium. The dissolution of NbC is controlled by the diffusion of niobium; the diffusion of niobium and carbon is induced by the balancing of their activities at the steel/sodium boundary. The local activity of carbon is at any moment determined via the steady state constant from the activity of niobium considering the type of carbide. The Nb-stabilized steel is characterized by a great difference in carbide sizes. Small carbides are accompanied by high carbon and niobium activities. Spontaneous diffusion occurs from the near vicinity of the carbides and the carbides dissolve. Stress increases activity thereby accelerating the process of decarburization of the steel in sodium.

45866 (INIS-mf—10145, pp 89-94) **Methods of estimating the service life of steam generator tubes considering the corrosion medium effect.** Machek, J.; Jaros, F. (Statni Vyzkumny Ustav pro Stavbu Stroju, Bechovice, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The corrosion effect is discussed of hot pressurized water on the service life of heat exchange tubes of the sodium evaporator of a fast reactor steam generator in the region of departure from nucleate boiling. The problems are discussed of corrosion fatigue of the tube material and of the propagation of small technological defects in the corrosion medium.

45867 (INIS-mf—10145, pp 95-104) **Analysis of conditions of corrosion fatigue of material of fast reactor steam generator evaporator and their simulation.** Kratochvil, J.; Walder, V.; Talpa, I. (Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav; Vyzkumny Ustav Hutnictvi Zeleza, Dobra, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The service life is discussed of part of the evaporator of a sodium steam generator at the point of departure from nucleate boiling. An oxidized layer develops on the surface of the metal. This layer slows down the process of corrosion in the hot water medium, in the steam medium it accelerates it. In Cr2.25Mo1 steel in both steam and water a magnetite surface layer develops which in dependence on hydrogen diffusion decelerates the corrosion process. In case hydrogen diffusion is prevented a magnetite double layer develops consisting of an inner porous layer and a compact outer layer. Point metal corrosion then develops under the porous layer. In points of departure from nucleate boiling, cyclic heat fatigue moreover supports cracking of the oxide layer and concentration of impurities. The oxygen content and purity of water are also important factors. A facility is presented for the simulation of corrosion conditions, developed by VUHZ Dobra. Corrosion fatigue tests will be carried out on sample tubes strained with an electrohydraulic pulsator at a throughflow of corrosion medium. Maximum temperatures will be restricted to 343 degC, pressure to 17.2 MPa and the volume of transported water to 1590 l/h.

45868 (ORNL—6301) **Transfer of modified 9Cr-1Mo steel technology through cooperative programs (1980-1985).** Sikka, V.K.; DiStefano, J.R.; Patriarca, P. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 67p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014397.

The principal objective of the United States Department of Energy (DOE) 9Cr-1Mo steel development program has been to provide the data and analyses required by designers for use of the alloy in advanced liquid metal reactors to reduce technical tasks and plant capital costs. It was recognized early that designers would not consider use of any material for nuclear applications unless there was a considerable body of experience already established. Toward this end, the plan has been to get the alloy accepted in Section I (Power Boilers), Section II (Materials Specifications), Section VIII (Pressure Vessels), and Section III (Nuclear power

Plant Components) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code as logical steps in the process. To achieve this objective, extensive interaction with the industrial community was considered mandatory. Accordingly, an intensive effort to achieve technology transfer was initiated, which resulted in the involvement of many organizations. This report is a compilation of 47 status sheets describing 35 participating organizations and funding sources, purpose of the interactions, material and product forms utilized, summary of the work completed, findings, and appropriate references. These interactions contributed significantly toward the fulfillment of the program goals.

45869 **(WAPD-TM—1555) Testing of a production irradiated fuel assay gauge (LWBR development program).** Kahler, A.C.; Tessler, G. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jul 1986. Contract AC11-76PN00014. 120p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86014405.

A gauge has been designed and constructed to measure, nondestructively, the fissile content of spent fuel rods from the Light Water Breeder Reactor (LWBR) Core. This gauge, called the Production Irradiated Fuel Assay Gauge (PIFAG) uses the method of active neutron interrogation and delayed neutron detection. A set of calibration rods fabricated with the LWBR core and with known, as-fabricated, fuel content and diameters and lengths characteristic of those in the LWBR core are used to calibrate the PIFAG for assay operations. Mechanical and physics testing of the PIFAG was carried out inside a mockup of the actual hot cells in which the PIFAG is being operated. Following extensive testing of mechanical operations, four californium sources containing a total of about 8 mg of ^{252}Cf were used to verify the nuclear operation of the gauge. PIFAG calibration was obtained for seed, power flattening blanket, and reflector rods. The variation of gauge response with rod speed and ambient temperature, the ability of the gauge to detect small axial gaps in the fuel stack, and the sensitivity of the gauge to the presence of water within the rods were determined. On-line methods for testing the quality of data were also investigated. It is concluded that the PIFAG mechanical and nuclear performance is capable of meeting the limit-of-error requirements for assay of spent LWBR core fuel rods. 42 figs.

45870 **(BLL-RISLEY-TR—280-(9091.9F)) Static and dynamic tensile tests on wide X 6 CrNi 18 11 steel plates to demonstrate the integrity of the reactor tank for the SNR 300 fast sodium-cooled reactor.** Breitling, H.; Laue, H.; Julisch, P.; Stradtmueller, W.; Sturm, D.; Wiedemann, J. (UKAEA Risley Nuclear Power Development Establishment). Oct 1985. Translated Statische und Dynamische Zugpruefungen mit Grossplatten aus Werkstoff X 6 CrNi 18 11 zum Integritaetsnachweis des Reaktortanks fuer den Schnellen Natriumgekuehlten Reaktor SNR 300 Stuttgart, West Germany. (CONF-8510153—5-Trans.). 26p. British Library Lending Div., Boston Spa, England.

From 11. MPA seminar; Stuttgart, F.R. Germany (10 Oct 1985).

The reactor tank of the SNR 300 fast sodium cooled reactor was subjected to a safety assessment which took account of the results of wide plate tensile tests, in which the elongation at maximum load was applied as the instability criterion. The wide plates were, to the greater part, welded in the longitudinal and transverse directions and incorporated experimental flaws, approximately 60 mm long and of defined depth and orientation, in order to take account of any undetected cracks in the original component. The tensile tests were carried out at temperatures up to 550 deg C and included dynamic tests as well as conventional quasistatic, so as to simulate stressing conditions in the tank during a hypothetical power excursion. The reference strain rate during these tests was epsilon = 1/s. Under quasistatic loading, flaw free plates reached elongations of approximately 33% and approximately 7.5% under dynamic loading with artificial defects in the form of a central slit or fatigue crack. With comparable plates, no significant differences were observed between the results of quasistatic and dynamic tests. 1 reference.

45871 **(RISLEY-Trans—4113) Fast reactor status review: mechanical and thermohydraulic core engineering of large breeders.** Kleefeldt, K. Translated from *KFK-Nachrichten ;* 10: No. 3-4, 50-53(1978). 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE85902082.

The design of a reactor core is an optimization problem where account must be taken in a considered manner of the to some extent conflicting interests in respect of reliability, handling, safety and profitability. With the computer programs available today, this is only possible using iterative procedures. This means that for the individual specialist fields, like physics, thermohydraulics, mechanics and fuel pin technology, it is necessary in the first place to perform separate calculations with to some extent estimated starting variables, which then have to be refined until sufficient consistency is attained. As part of the initial planning for a 1300-MWe-plant, in collaboration with the institutes IMF, INR, IRB, IRE and the firms Belgonucleaire and Interatom a core of the type of the normal cylindrical two-zone core has been designed which will be used as a provisional working basis, among other things also for the forthcoming safety analyses. The following accounts of the methods and of a number of findings in the fields of mechanics and thermohydraulics are centered on this so-called homogeneous working core.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

45872 **(BNL—38312) Use of nuclear energy for bimodal applications in space.** Horn, F.L.; Powell, J.R.; Ludewig, H. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 6p. (CONF-860810—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014124.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

The versatile bimodal nuclear reactor is proposed for producing space station-keeping power of 100's kW and also capable of bursts of power by ramping to 100's MW for short times to operate high power magnetic systems. The particle bed reactor, using half-millimeter diameter fuel particles immersed in coolant, provides the heat transfer capability needed for this power level. The coolant is a gas when directly coupled to a Brayton Cycle and is particularly responsive. The reactor design uses 37 fuel elements in a triangular pattern held in a cylindrical core. The reactor, radiator and turbogenerator are packaged for insertion into the shuttle cargo bay.

45873 **SP-100 program developments.** Schnyer, A.D.; Sholtis, J.A. Jr.; Wahlquist, E.J.; Verga, R.L.; Wiley, R.L. (NASA, Washington, DC; DOE, Washington, DC; DOD, Strategic Defense Initiative Organization, Washington, DC). pp 1.17-1.25 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

An update is provided on the status of the SP-100 Space Reactor Power Program. The historical background that led to the program is reviewed and the overall program objectives and development approach are discussed. The results of the mission studies identify applications for which space nuclear power is desirable and even essential. Results of a series of technology feasibility experiments are expected to significantly improve the earlier technology data base for engineering development. The conclusion is reached that a nuclear reactor space power system can be developed by the early 1990s to meet emerging mission performance requirements.

45874 **Application and use of nuclear power for future spacecraft.** Wetch, J.R.; Begg, L.L.; Dick, R.S. (Space Power, Inc., Sunnyvale, CA). pp 1.26-1.31 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Recent plans for growth of civil and military applications of spacecraft and satellites has intensified interest in the use of nuclear power in space. Potential developers of nuclear power reactors and/or conversion systems have provided past papers describing various particular design aspects of their respective systems. This paper provides potential power system users with spacecraft integration concepts and limited data, that may help them identify where and how nuclear power may best be used to meet spacecraft systems power requirements. The paper discusses overall power system size, mass, thermal management, spacecraft configuration, and shielding of unmanned man-visited and continuously-manned systems. Discussion relative to safety imposed limitations and orbital maintenance limitations are included. 6 references.

45875 **Tethered nuclear power for the space station.** Bents, D.J. (NASA, Lewis Research Center, Cleveland, OH). pp 1.210-1.227 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

A nuclear space power system the SP-100 is being developed for future missions where large amounts of electrical power will be required. Although it is primarily intended for unmanned spacecraft, it can be adapted to a manned space platform by tethering it above the station through an electrical transmission line which isolates the reactor far away from the inhabited platform and conveys its power back to where it is needed. The transmission line, used in conjunction with an instrument rate shield, attenuates reactor radiation in the vicinity of the space station to less than one-one hundredth of the natural background which is already there. This combination of shielding and distance attenuation is less than one-tenth the mass of boom-mounted or onboard man-rated shields that are required when the reactor is mounted nearby. This paper describes how connection is made to the platform (configuration, operational requirements) and introduces a new element the coaxial transmission tube which enables efficient transmission of electrical power through long tethers in space. Design methodology for transmission tubes and tube arrays is discussed. An example conceptual design is presented that shows SP-100 at three power levels 100 kWe, 300 kWe, and 1000 kWe connected to space station via a 2 km HVDC transmission line/tether. Power system performance, mass, and radiation hazard are estimated with impacts on space station architecture and operation. 23 references.

45876 **Reactor/organic Rankine conversion - a sota solution to near term high power needs in space.** Niggemann, R.E.; Lacey, D. (Sundstrand Corp., Rockford, IL). pp 1.352-1.357 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

A nuclear Organic Rankine Cycle (ORC) system contains a sodium cooled reactor with a 783 K outlet temperature, an intermediate sodium loop interfacing with the vaporizers of two redundant power conversion units (PCUs) and a deployable heat pipe radiator. It is pointed out that the considered arrangement minimizes system weight while providing high reliability and eliminating single-point failures in the power conversion subsystem. Attention is given to a system description, reactor selection, the secondary loop, the PCUs system performance, system packaging, technology status, and growth potential. It is concluded that the nuclear-powered ORC is limited to several hundreds of kilowatts. However, it is implementable with existing technology. As reactor temperature capability improves and power requirements exceed several hundred kilowatts, it will probably be possible to utilize liquid metal Rankine cycles for a satisfaction of advanced system requirements. 16 references.

45877 **Space nuclear power plant technology development philosophy for a ground engineering phase.** Buden, D.; Trapp, T.J. (Science Applications International Corp., Albuquerque, NM; Los Alamos National Lab., NM). pp 1.358-1.366 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The development of a space qualified nuclear power plant is proceeding from the technical assessment and advancement phase to the ground engineering phase. In this new phase, the selected concept will be matured by the completion of activities needed before protoflight units can be assembled and qualified for first flight applications. This paper addresses a possible philosophy to arrive at the activities to be performed during the ground engineering phase. The philosophy is derived from what we believe a potential user of nuclear power would like to see completed before commitment to a flight development phase. 5 references.

45878 **Overview of the 1985 NASA Lewis Research Center SP-100 free-piston Stirling engine activities.** Slaby, J.G. (NASA, Lewis Research Center, Cleveland, OH). pp 3.180-3.188 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

This effort is keyed on the design, fabrication, assembly, and testing of a 25 kWe Stirling space-power technology-feasibility demonstrator engine. Another facet of the SP-100 project covers the status of a 9000-hr endurance test conducted on a 2 kWe free-piston Stirling/linear alternator system employing hydrostatic gas bearings. Dynamic balancing of the RE-1000 engine (a 1 kWe free-piston Stirling engine) using a passive dynamic absorber will be discussed along with the results of a parametric study showing the relationships of Stirling power converter specific weight and efficiency as functions of Stirling engine heater to cooler temperature ratio. Planned tests will be described covering a hydrodynamic gas bearing concept for potential SP-100 application. 15 references.

45879 **Static and dynamic high power, space nuclear electric generating systems.** Wetch, J.R.; Begg, L.L.; Koester, J.K. (Space Power, Inc., Sunnyvale, CA). pp 3.513-3.520 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Space nuclear electric generating systems concepts have been assessed for their potential in satisfying future spacecraft high power (several megawatt) requirements. Conceptual designs have been prepared for reactor power systems using the most promising static (thermionic) and the most promising dynamic conversion processes. Component and system layouts, along with system mass and envelope requirements have been made. Key development problems have been identified and the impact of the conversion process selection upon thermal management and upon system and vehicle configuration is addressed. 10 references.

45880 **TEC and ultralloys for high-power space systems.** Morris, J.F.; Jacobson, D.L. (Arizona State Univ., Tempe). pp 3.521-3.527 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Increasing space nuclear reactor (SNR) power requirements force system weights and temperatures upward. For such growth, thermionic energy conversion (TEC) excels in SNR service between tenths of a megawatt and about ten megawatts. TEC yields much current at low voltage, and, as total outputs soar, radiators at

400 K for conventional power conditioning (PC) balloon, compared with those at 1000 K and higher for TEC itself. To reduce PC problems, TEC requires contiguous high-temperature inversion or internal electromagnetic wave generation. Both are possible, potentially practical, and probably exploitable through research. However, attaining suitable efficiencies with these different operating modes and higher rejection temperatures demands new electrode and additive technologies, as well as decreased cesium pressures and increased TEC temperatures. Furthermore, such thermal growth necessitates alloys that approach ultimate metal capabilities for space applications. 19 references.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 45856, 45860

2108 Economics

45881 **(ORNL/Sub—85-7685/1-11) Power plant economy of scale and cost trends: further analyses and review of empirical studies.** Fisher, C.F. Jr.; Paik, S.; Schriver, W.R. (Tennessee Univ., Knoxville (USA). Construction Resources Analysis). Jul 1986. Contract AC05-84OR21400. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86014410.

Multiple regression analyses were performed on capital cost data for nuclear and coal-fired power plants in an extension of an earlier study which indicated that nuclear units completed prior to the accident at Three-Mile Island (TMI) have no economy of scale, and that units completed after that event have a weak economy of scale (scaling exponent of about 0.81). The earlier study also indicated that the scaling exponent for coal-fired units is about 0.92, compared with conceptual models which project scaling exponents in a range from about 0.5 to 0.9. Other empirical studies have indicated poor economy of scale, but a large range of cost-size scaling exponents has been reported. In the present study, the results for nuclear units indicate a scaling exponent of about 0.94 but with no economy of scale for large units, that a first unit costs 17% more than a second unit, that a unit in the South costs 20% less than others, that a unit completed after TMI costs 33% more than one completed before TMI, and that costs are increasing at 9.3% per year. In the present study, the results for coal-fired units indicate a scaling exponent of 0.93 but with better scaling economy in the larger units, that a first unit costs 38.5% more, a unit in the South costs 10% less, flue-gas desulfurization units cost 23% more, and that costs are increasing at 4% per year.

45882 **(ORNL/TM—10071) Cost estimate guidelines for advanced nuclear power technologies.** Hudson, C.R. II. (Oak Ridge National Lab., TN (USA). Engineering Technology Div.). Jul 1986. Contract AC05-84OR21400. 101p. NTIS, PC A06/MF A01; GPO Dep. File Number DE86014412.

To make comparative assessments of competing technologies, consistent ground rules must be applied when developing cost estimates. This document provides a uniform set of assumptions, ground rules, and requirements that can be used in developing cost estimates for advanced nuclear power technologies.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

45883 **(AEEW-R—1962) Subgroup version of MONK.** Hutton, J.L. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1985. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703178.

The Monte Carlo neutronics code MONK is used for a wide range of applications from criticality to reactor modelling. To extend the range and to remove a limitation of the group data version of the code, the subgroup method has been combined into MONK. This note outlines the basis of the subgroup model adopted for this development, together with the results of a series of validation/verification calculations designed to demonstrate the accuracy and usefulness of this development.

45884 **(JAERI-M—84-219) Calculation of critical parameters for uranium and/or plutonium nitrate solution, 2. Discussion of basic critical parameters for nitrate solution system.** Miyoshi, Yoshinori; Ami, Norio; Tachimori, Shoichi. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Dec 1984. 62p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE86703180.

For the purpose of criticality experiments of the nitrate solution systems composed of uranium and/or plutonium, the designs of Criticality Safety Experimental Facility(CSEF) are under-going in JAERI. In this report, by using the developed calculational code for the atomic number density of the nitrate solution of U/Pu mixture, the ratio H/Fissile has been calculated as a function of fuel concentration and acidity. Critical parameters such as infinite multiplication factor, effective multiplication factor, and the critical diameter of infinite cylinder have been evaluated with Monte Carlo code KENO-IV of JACS system. The dependence of multiplication factors on the formula for the atomic number density is described by comparing the calculated results with our formula and those with ARH-600 formula. Based on our formula, the effects of acid molality and Plutonium valence state on the criticality of nitrate solution have been discussed.

45885 **(JAERI-M—85-034) Collision probability in two-dimensional lattice by ray-trace method and its applications to cell calculations.** Tsuchihashi, Keichiro. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 217p. NTIS (US Sales Only), PC A10/MF A01. File Number DE86703182.

A series of formulations to evaluate collision probability for multi-region cells expressed by either of three one-dimensional coordinate systems (plane, sphere and cylinder) or by the general two-dimensional cylindrical coordinate system is presented. They are expressed in a suitable form to have a common numerical process named "Ray-Trace" method. Applications of the collision probability method to two optional treatments for the resonance absorption are presented. One is a modified table-look-up method based on the intermediate resonance approximation, and the other is a rigorous method to calculate the resonance absorption in a multi-region cell in which nearly continuous energy spectra of the resonance neutron range can be solved and interaction effect between different resonance nuclides can be evaluated. Two works on resonance absorption in a doubly heterogeneous system with grain structure are presented. First, the effect of a random distribution of particles embedded in graphite diluent on the resonance integral is studied. Next, the "Accretion" method proposed by Leslie and Jonsson to define the collision probability in a doubly heterogeneous system is applied to evaluate the resonance absorption in coated particles dispersed in fuel pellet of the HTGR. Several optional models are proposed to define the collision rates in the medium with the microscopic heterogeneity. By making use of the collision probability method developed by the present study, the JAERI thermal reactor standard nuclear design code system SRAC has been developed. Results of several benchmark tests for the SRAC are presented. The analyses of critical experiments of the SHE, DCA, and FNR show good agreement of critical masses with their experimental values.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 45948, 46150, 46393

45886 **(EPRI-NP—4625) Laboratory examinations of selected tubes from test facilities of the Steam Generator Owners Group. Final report.** Prestegiacomo, J.B.; Jacko, R.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Steam Generator Technology Div.). Jul 1986. 277p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920432.

This report documents work conducted to evaluate alloy 600 tubing under tube supports tested in SGOG I projects. The majority of tube-tube support specimens were exposed to denting-type en-

vironments. Evaluation of these specimens revealed only superficial tube attack, including surface roughening, pitting, and intergranular penetrations (in decreasing order of frequency). Concurrently, an in-depth investigation, including microstructural and microanalytical evaluations and previously reported data, concluded that non-sensitized thermally treated alloy 600 tubing cracked in a sulfate environment that also caused wastage. Of the factors considered in this work, i.e., chemical environment, tubing microstructure, and mechanical effects, the mechanical component (dynamic plastic straining during test) may have had the greatest contribution relative to promoting stress corrosion cracking (SCC) in the tubing. 93 figs., 33 tabs.

45887 **(EPRI-NP—4705) Electrochemistry and corrosion of alloys in high-temperature water. Final report.** Bogaerts, W.F.; Bettendorf, C. (Leuven Univ. (Belgium). ECHEM Labs.). Jul 1986. 161p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920435.

The effect of potential and temperature on the passivity and its localized breakdown on nickel base alloys in dilute aqueous solutions has been studied at temperatures ranging from 50 to 300°C, emphasizing the role of environmental variables, such as temperature, solution composition (e.g. Cl^-) and pH. A critical potential, above which passivity breakdown and/or pitting occurs, has been determined as a function of temperature. Changes in pitting morphologies and growth kinetics are discussed in terms of surface film compositions and electrochemical properties. Some specific features of high temperature pits (e.g. IGA at pit bottoms) are explained. The report also presents a preliminary survey of the chemistry of surface films formed on Fe-Cr-Ni alloys in high temperature aqueous environments and suggests possible mechanisms underlying corrosion behavior of Alloy 600 or Type 304 stainless steel in these media.

2203 Fuel Elements

45888 **(BARC—1276) Environment induced cracking of Zircaloy-2 fuel cladding tube.** Ghosal, S.K.; De, P.K. (Bhabha Atomic Research Centre, Bombay (India); Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). 1985. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703183.

The influence of iodine vapour on the stress corrosion cracking (SCC) behaviour of Zircaloy-2 fuel cladding tubes has been studied. SCC tests have been carried out by internal pressurisation technique in the temperature range of 300-400degC, with applied stress varying from 16-37 kg/mm^2. The iodine concentration was varied from 1 mg/cm^2 to 10 mg/cm^2 of the exposed surface of Zircaloy tubes. Time-of-failure of the stress-relieved tubes was found to be strongly dependent on iodine concentration, temperature and applied hoop stress. The time-to-failure was found to increase from 6 minutes to 10 hours as the iodine concentration was decreased from 10 mg/cm^2 to 1 mg/cm^2. Similarly with 1 mg/cm^2 iodine, the time-to-failure was increased by about 20 times by lowering the temperature from 400degC to 300degC. It has been observed that for the tube to fail by SCC, applied hoop stress should be around the yield stress of the material. Experiments under similar conditions were also carried out with graphite coated (inside surface only - CANLUB) Zircaloy-2 tubes. Results indicated that graphite coated tubes are more resistant to SCC as compared to the bare tubes. In order to find the SCC behaviour of the Zircaloy-2 tubes under power ramp condition, SCC tests were also carried out in which the temperature was increased suddenly from 300degC to 500degC. It was found that the life time of the graphite coated tubes is about 1.5 times longer than that of the bare tubes. SEM examination showed the presence of corrosion products at the inside surface of tubes failed by SCC. The mechanism of failure appears to be one of mechanical fracture assisted by chemical attack. In the presence of iodine, preoxidised tubes had increased the life time, but the hydrided tubes failed within a very short time. Presence of cadmium has been observed to be harmful. 27 refs., 4 tables, 10 figures.

2204 Control Systems

REFER ALSO TO CITATION(S) 45903, 45907

45889 **(JAERI-M—85-032) Measurements and analyses on reactivity effects of absorber rods in a light-water moderated UO_2 lattices.** Murakami, Kiyonobu; Miyoshi, Yoshinori; Hirose, Hideyuki; Suzaki, Takenori. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 23p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. File Number DE86703181.

Reactivity effects and reactivity-interference effects of absorber rods were measured with a cylindrical core aiming to obtain bench-marks for verification of the calculational methods. The core consisted of 2.6 w/o enriched UO_2 fuel rods lattice of which water-to-fuel volume ratio was 1.83. In the experiment, the critical water levels were measured changing neutron absorber content of absorber rods and the distance between two absorber rods in the core center. Monte Calro codes KENO-IV and MULTI-KENO were used to calculate reactivity worthes of absorber rods. The calculational results of effective multiplication factors ranged from 0.978 to 0.999 for the 60 cases of critical cores with inserted absorber rods. The calculational results of absorber worthes agreed to the experimental results within twice of the standerd deviation accompanied with the Monte Calro calculation.

45890 **(NUREG/CR—4532-Vol.1) Models of cognitive behavior in nuclear power plant personnel. A feasibility study: summary of results. Volume 1.** Woods, D.D.; Roth, E.M.; Hanes, L.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jul 1986. 27p. NTIS, PC A03/MF A01 - GPO. File Number TI86901610.

This report summarizes the results of a feasibility study to determine if the current state of models of human cognitive activities can serve as the basis for improved techniques for predicting human error in nuclear power plants emergency operations. Based on the answer to this question, two subsequent phases of research are planned. Phase II is to develop a model of cognitive activities, and Phase III is to test the model. The feasibility study included an analysis of the cognitive activities that occur in emergency operations and an assessment of the modeling concepts/tools available to capture these cognitive activities. The results indicated that a symbolic processing (or artificial intelligence) model of cognitive activities in nuclear power plants is both desirable and feasible. This cognitive model can be built upon the computational framework provided by an existing artificial intelligence system for medical problem solving, called Caduceus. The resulting cognitive model will increase the capability to capture the human contribution to risk in probabilistic risk assessment studies. Volume 1 summarizes the major findings and conclusions of the study. Volume 2 provides a complete description of the methods and results, including a synthesis of the cognitive activities that occur during emergency operations, and a literature review on cognitive modeling relevant to nuclear power plants. 19 refs.

45891 **(NUREG/CR—4532-Vol.2) Models of cognitive behavior in nuclear power plant personnel. A feasibility study: main report. Volume 2.** Woods, D.D.; Roth, E.M.; Hanes, L.F. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jul 1986. 178p. NTIS, PC A09/MF A01 - GPO. File Number TI86901611.

This report contains the results of a feasibility study to determine if the current state of models human cognitive activities can serve as the basis for improved techniques for predicting human error in nuclear power plants emergency operations. Based on the answer to this questions, two subsequent phases of research are planned. Phase II is to develop a model of cognitive activities, and Phase III is to test the model. The feasibility study included an analysis of the cognitive activities that occur in emergency operations and an assessment of the modeling concepts/tools available to capture these cognitive activities. The results indicated that a symbolic processing (or artificial intelligence) model of cognitive activities in nuclear power plants is both desirable and feasible. This cognitive model can be built upon the computational framework

provided by an existing artificial intelligence system for medical problem solving called Caduceus. The resulting cognitive model will increase the capability to capture the human contribution to risk in probabilistic risk assessments studies. Volume I summarizes the major findings and conclusions of the study. Volume II provides a complete description of the methods and results, including a synthesis of the cognitive activities that occur during emergency operations, and a literature review on cognitive modeling relevant to nuclear power plants. 112 refs., 10 figs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 45949, 45950, 46662, 46682

45892 (PNL—5870) Method for assigning sites to projected generic nuclear power plants. Holter, G.M.; Purcell, W.L.; Shutz, M.E.; Young, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014191.

Pacific Northwest Laboratory developed a method for forecasting potential locations and startup sequences of nuclear power plants that will be required in the future but have not yet been specifically identified by electric utilities. Use of the method results in numerical ratings for potential nuclear power plant sites located in each of the 10 federal energy regions. The rating for each potential site is obtained from numerical factors assigned to each of 5 primary siting characteristics: (1) cooling water availability, (2) site land area, (3) power transmission land area, (4) proximity to metropolitan areas, and (5) utility plans for the site. The sequence of plant startups in each federal energy region is obtained by use of the numerical ratings and the forecasts of generic nuclear power plant startups obtained from the EIA Middle Case electricity forecast. Sites are assigned to generic plants in chronological order according to startup date.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 45725, 45904

45893 (DOE/ER/10229—23) University of Wisconsin Nuclear Reactor Laboratory, Madison, Wisconsin. Annual report, fiscal year 1985-1986. Cashwell, R.J. (Wisconsin Univ., Madison (USA). Nuclear Reactor Lab.). 1986. Contract FG02-81ER10229. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014352.

This report presents a summary of the operations and programs carried out for the University of Wisconsin Nuclear Reactor Laboratory for the fiscal year 1985-1986. Information is presented on: instructional use - UW-Madison formal classes; reactor sharing program; utility personnel training; sample irradiations and neutron activation analysis services; changes in personnel, facility, and procedures; and results of surveillance tests.

45894 (EGG-M—22985) Irradiation facilities at the Idaho National Engineering Laboratory. Gupta, V.P.; Herring, J.S.; Korenke, R.E.; Harker, Y.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 24p. (CONF-860605—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013469.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Although there is a growing need for neutron and gamma irradiations by governmental and industrial organizations in the United States and in other countries, the number of facilities providing such irradiations are limited. At the Idaho National Engineering Laboratory, there are several unique irradiation facilities producing high neutron and gamma radiation environments. These facilities could be readily used for nuclear research, materials testing, radiation hardening studies on electronic components/circuitry and sensors, and production of neutron transmutation doped (NTD) silicon and special radioisotopes. In addition, a neutron radiography unit, suitable for examining irradiated materials and assemblies, is also available. This paper provides a description of the irradiation facilities and the neutron radiography unit as well as examples of their unique applications.

45895 (JAERI-M—85-016) Study on evaluation methods of explosive proof tests of NSRR capsule. Yamazaki, Toshi. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 53p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. File Number DE86703193.

This report describes the methods of evaluation of chemical explosive tests results in NSRR. The report is composed of the requirements for NSRR capsule design, the methods for chemical explosive tests, the existing evaluation method and a proposal for a new method of evaluation of explosive proof test results.

45896 (JAERI-M—85-021) Development of the power ramping facility at JMTR. Results of performance test on the boiling water capsule. Nakata, Hirokatsu; Sezaki, Katsuji; Nakazaki, Chosaburo; Ishii, Tadahiko; Ito, Haruhiko; Abe, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). Mar 1985. 40p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE86703194.

The LWR fuel power ramping facility have been being developed at JMTR since 1978. This report, following previous reports, JAERI-M 8533 and 9343, summarizes the results of performance test performed in 1981 on the ^{3}He power controlled boiling water capsule, which is a basic part of the facility. Various measurements were carried out during reactor operation on each part of the capsule, i.e. capsule itself, capsule control unit and ^{3}He power control unit, after a long-time cold run test of the units. Through the test, it was confirmed that the capsule satisfies the specifications which stated that LWR fuel pin should be power-ramped under BWR conditions up to 50 kW/m with a change factor of more than 2, and that the control units operate in a good condition.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 45893

45897 (DPST—85-1-11) Savannah River Laboratory monthly report, November 1985. (SEE CODE- 9520932 Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Nov 1985. Contract AC09-76SR00001. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008913.

This report presents information concerning: nuclear reactors and scientific computations; chemical processes and environmental technology; and defense waste and laboratory operations for the Savannah River Laboratory. (JDB)

45898 (DPST—86-1-1) Savannah River Laboratory monthly report, January 1986. (SEE CODE- 9520932 Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jan 1986. Contract AC09-76SR00001. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008909.

This report presents information concerning: nuclear reactors and scientific computations; chemical processes and environmental technology; and defense waste and laboratory operations for the Savannah River Laboratory. (JDB)

2209 Reactor Safety

REFER ALSO TO CITATION(S) 45890, 45891

45899 (AEEW-R—1874) BERTHA: a programme for the thermal/hydraulic analysis of reflooding experiments. Pearson, K.G.; Cooper, C.A. (UKAEA Atomic Energy Establishment, Winfrith). Apr 1985. 100p. (PWR/HTWG/P—85-311). NTIS (US Sales Only), PC A05/MF A01. File Number DE86703189.

In the event of a large break loss-of coolant accident in a PWR the normal cooling would be restored by reflooding the dry overheated reactor core from below. A model, BERTHA, of heat transfer in this dry region is presented. It includes a film boiling and dispersed flow region and explicitly represents the effect of spacer grids. In parallel channel mode it can calculate the effect of partial flow blockage. Predictions of the model are compared with experimental data and show good agreement in both blocked and unblocked configurations.

45900 (AEEW-R—1933) Mathematical model of vapour film destabilisation. Knowles, J.B. (UKAEA Atomic Energy Establishment, Winfrith). Apr 1985. 74p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86703166.

In a hypothetical reactor accident, destabilisation of an intervening vapour film between the molten fuel and liquid coolant by a weak shock wave (trigger), is considered likely to initiate the molten fuel-coolant interaction. The one-dimensional model presented here is part of a larger programme of fundamental research aimed at improved reactor safety.

45901 (BNL-NUREG—37691) Systematic approach to containment performance criteria. Park, C.; Bari, R.; Kerr, W. (Brookhaven National Lab., Upton, NY (USA). Nuclear Energy Dept.). 1986. Contract AC02-76CH00016. 5p. (CONF-860610—16). NTIS, PC A02/MF A01 - GPO. File Number TI86007123.

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The objective of this study is to demonstrate how to specify containment performance criteria in a systematic way given top level safety goals. The multiobjective optimization approach proposed by Cho, et al. was adopted as a method for deriving a finite manageable set of self-consistent relations between the top level safety goals and specific sets of measures of containment performance. The current trial safety goals proposed by the NRC goes from a design objective figure of 10^{-4} for annual frequency of core melt to guideline numbers for early fatalities and for delayed fatalities. An alternative is to specify containment system performance in some quantitative fashion. If this can be done, and if the specified performance can be demonstrated with some reasonable level of confidence, it will help to provide greater consistency between top level safety goals (health risk indices) and lower level design objectives (plant performance indices, i.e., core melt frequency and containment performance criteria).

45902 (CLM-R—256) Transient debris bed calculations in one dimension. Brealey, N.J. (UKAEA Culham Lab., Abingdon). Sep 1985. 27p. H.M. Stationery Office, London price Pound 4.00.

A model for transient heat and mass transfer in internally heated debris beds is described. The model is based on conservation laws for mass and energy with phenomenological laws for flow through a porous medium. A numerical scheme based on an enthalpy method has been developed: the scheme for one dimensional beds has been implemented in the code ENTH. Two example calculations are presented. Some model limitations and possible enhancements of ENTH are discussed.

45903 (CONF-860204—39) Instrument accuracy in reactor vessel inventory tracking systems. Anderson, J.L.; Anderson, R.L.; Morelock, T.C.; Hauang, T.L.; Phillips, L.E. (Oak Ridge National Lab., TN (USA). Instrumentation and Controls Div.; Nuclear Regulatory Commission, Washington, DC (USA)). 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008993.

From Thermal reactor safety meeting; San Diego, CA, USA (2 Feb 1986).

Instrumentation needs for detection of inadequate core cooling. Studies of the Three Mile Island accident identified the need for additional instrumentation to detect inadequate core cooling (ICC) in nuclear power plants. Industry studies by plant owners and reactor vendors supported the conclusion that improvements were needed to help operators diagnose the approach to or existence of ICC as well as to provide more complete information for operator control of safety injection flow to minimize the consequences of such an accident. In 1980, the US Nuclear Regulatory Commission (NRC) required further studies by the industry and described ICC instrumentation design requirements that included human factors and environmental considerations. On December 10, 1982, NRC issued to Babcock and Wilcox (B and W) licensees orders for Modification of License and transmitted to pressurized water reactor licensees Generic Letter 82-28 to inform them of the revised NRC requirements. The instrumentation requirements include upgraded subcooling margin monitors (SMM), upgraded core exit thermocouples (CET), and installation of a reactor coolant inventory tracking system. NRC Regulatory Guide 1.97, which covers accident monitoring instrumentation, was revised (Rev. 3) to be consistent with the requirements of item II.F.2 of NUREG-0737.

45904 (CONF-860501—15) Progress and future plans in the PFR/TREAT safety testing programs. Alter, H.; Cowking, C.B.; Klickman, A.E.; Wood, M.H. (Argonne National Lab., IL (USA); UKAEA Risley Nuclear Power Development Establishment; UKAEA Atomic Energy Establishment, Winfrith). 1986. Contract W-31-109-ENG-38. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014494.

From Conference on the science and technology of fast reactor safety; Channel Islands, UK (12 May 1986).

This paper briefly describes the progress to date on the joint UKAEA/USDOE program of fast reactor fuel safety testing and the definition of the future tests. The program involves transient tests in the TREAT reactor on fresh and irradiated mixed fuel pins. The tests simulate transient overpower (TOP) accidents, which result from an unintentional addition of reactivity and transient undercooling followed by overpower (TUCOP) accidents, which arise from an unintentional stoppage of the primary sodium circulating pumps, both with failure to scram. Thirteen tests have been performed to date, all on UK pins. Future plans include five tests, all on US pins which have been irradiated in FFTF. Much has been learned about the behavior of fuel driven to conditions well beyond those existing during normal reactor operation.

45905 (CONF-860610—2) Top-down versus bottom-up processing of influence diagrams in probabilistic analysis. Timmerman, R.D.; Burns, T.J.; Dodds, H.L. Jr. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 1986. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01 - GPO. File Number TI86005151.

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Recent work by Phillips and Selby has shown that influence diagram methodology can be a useful analytical tool in reactor safety studies. In some instances an influence diagram can be used as a graphical representation of probabilistic dependence within a system or event sequence. Under these circumstances, Bayesian statistics is employed to transform the relationships depicted in the influence diagram into the correct expression for a desired marginal probability (e.g. the top node). Top-down and bottom-up algorithms have emerged as the dominant methods for quantifying influence diagrams. The purpose of this paper is to demonstrate a potential error in employing the bottom-up algorithm when dealing with interdependencies.

45906 (CONF-860932—1) **Relocation tabletop exercise: federal radiological response in the post-accident phase.** Grant, K.; Adler, M.V.; Wolff, W.F. (Oak Ridge National Lab., TN (USA); USDOE Assistant Secretary for Environment, Safety and Health, Washington, DC. Office of Nuclear Safety). 1986. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008499.

From Radiological accidents, perspectives and emergency planning preparedness; Bethesda, MD, USA (15 Sep 1986).

The federal Radiological Emergency Response Plan (FRERP) was developed to provide the framework for coordinating federal radiological assistance to states and to local authorities faced with a large radiological accident. The Relocation Tabletop Exercise was conducted on December 9-11, 1985 at the Beaver Valley Power Station, the site of the simulated accident. The exercise scenario had postulated a substantial release of radioactive materials from a fuel handling accident at the Beaver Valley Power Station in Shippingport, Pennsylvania, leaving radioactive materisls deposited over part of the surrounding area. The exercise was structured as a sequential series of nice mini-scenarios, each of which focused on one problems. The exercise was intended to identify issues and problems which needed consideration or procedures which might need to be developed for this post-accident phase. It was a "no-fault" excercise.

45907 (DOE/NE/37945—1) **Simulation-based expert system for nuclear reactor control and diagnostics. Progress report.** Lee, J.C.; Martin, W.R. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). 31 Jul 1986. Contract AC02-85NE37945. 18p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014668.

This research concerns the development of artificial intelligence (AI) techniques suitable for application to the diagnostics and control of nuclear power plant systems. The overall objective of the current effort is to build a prototype simulation-based expert system for diagnosing accidents in nuclear reactors. The system is being designed to analyze plant data heuristically using fuzzy logic to form a set of hypotheses about a particular transient. Hypothesis testing, fault magnitude estimation and transient analysis is performed using simulation programs to model plant behavior. An adaptive learning technique has been developed for achieving accurate simulations of plant dynamics using low-order physical models of plant components. The results of the diagnostics and simulation analysis of the plant transient are to be analyzed by an expert system for final diagnoses and control guidance. To date, significant progress has been made toward achieving the primary goals of this project. Based on a critical safety functions approach, an overall design for the nuclear plant expert system has been developed. The methodology for performing diagnostic reasoning on plant signals has been developed and the algorithms implemented and tested. A methodology for utilizing the information contained in the physical models of plant components has also been developed. This work included the derivation of a unique Kalman filtering algorithm for using power plant data to systematically improve on-line simulations through the judicious adjustment of key model parameters. A few simulation models of key plant components have been developed and implemented to demonstrate the method on a realistic accident scenario. The chosen transient is a loss of feed flow exasperated by a stuck open relief valve, similar to the initiating event of the Three Mile Island Unit 2 accident in 1979.

45908 (EPRI-NP—4455, pp 1.1-1.12) **Research related to severe reactor accidents.** Kerr, W. (Univ. of Michigan, Ann Arbor). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

One might describe the objectives of severe accident research as obtaining information needed to make decisions on the appropriate way to deal with the risk of severe accidents. Establishing an appropriate policy for dealing with severe accidents is manifestly difficult, and requires consideration of questions both political and scientific. Emphasis on severe LWR accident research was accelerated immediately following the TMI2 accident. Since that time a significant body of information has been collected. What is needed at this time is a synthesis of the existing information into a coherent policy. Such a synthesis will point to and help establish priorities for additional research that may be needed. Comments are made on some areas that appear to merit further exploration, and on possible approaches to a coherent policy.

45909 (EPRI-NP—4455, pp 3.1-3.16) **Flooding in particle beds and its role in dryout heat flux prediction.** Schrock, V.E.; Wang, C.H.; Revankar, S.; Wei, L.H.; Lee, S.Y.; Squarer, D. (Univ. of California). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

In recent years a large amount of research has been conducted to develop the ability to analyze the evolution of severe core damage in postulated LWR accidents. The ability to remove decay power from a bed of debris particles following severe core damage has been the subject of many theoretical and experimental studies and a number of models have been proposed for the dryout heat flux. The flooding process, i.e., the hydrodynamic limit on the necessary counter current flow, has been suggested as one of the controlling mechanisms for beds cooled by liquid supplied only above the bed. An experimental investigation has been conducted on flooding of steam and water in isothermal homogeneous beds of particles with an overlying two-phase pool. The beds were spherical particles of 8, 16 and 39 mm diameter and cylinders 16 mm in diameter and length in cylindrical test sections 15 and 30 cm in diameter. Water was injected into the overlying pool at saturation temperature or with 50°C of subcooling. A new correlation was obtained which provides improved prediction of dryout heat flux for internally heated beds. A theoretical prediction of flooding, based upon relative permeabilities for two-phase flow proposed by Lipinski, was found to agree rather well with the new correlation. A limited study of multi-dimensional effects was included in the experimental program.

45910 (EPRI-NP—4455, pp 4.1-4.9) **Refined model for the coolability of core debris with flow entry from the bottom.** Schulenberg, T.; Mueller, U. (Dornier System GmbH, Friedrichshafen, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Within the context of a hypothetical severe accident in light water reactors also heat generating debris beds of a coarse particle size are discussed. A refined model for two-phase flow in particle beds is presented. Compared to previous models this model takes into account the effect of interfacial drag forces between liquid and vapor. These effects are important in coarse debris beds. The model is based on the momentum equations for separated flow, which are closed by empirical relations for the wall shear stress and the interfacial drag. When the refined model is applied to LWR severe accident scenarios an increased dryout heat flux is predicted for debris beds with flow entry from the bottom driven by a moderate downcomer head.

45911 (EPRI-NP—4455, pp 5.1-5.20) **Two-phase flow in stratified porous media.** Lee, H.S.; Catton, I. (Univ. of California, Los Angeles). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Light-water reactor accident sequences postulate the formation of particulate beds of core debris materials. In assessing this potential problem, pressure drop and void-fraction for liquid-gas concurrent upward flow in porous media are correlated from the experiments performed in one-dimensional packed beds of glass spheres. A nonhomogeneous two-dimensional structure of porous material is then considered. Analysis is done for the multi-dimensional porous media by following the classical approach of continuum-relative permeability model. Solutions are obtained by a finite-difference numerical scheme. The calculated pressure and void-fraction profiles are in good agreement with the experimental measurements.

45912 (EPRI-NP—4455, pp 6.1-6.13) **Transient analysis of debris bed heat transfer.** Brealey, N.J.; Moore, K.A.; Turland, B.D. (UKAEA, Abingdon, England). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

One-dimensional models of steady-state heat transfer from a bed of self-heated particulate debris by a boiling coolant have been developed which are based on the concepts of two-phase flow through a porous medium. These models provide reasonable predictions of the dryout heat flux for a wide variety of particulates and coolants; they also provide explanations of the deleterious effects of bed stratification and the existence of stable dry-zones found in some experiments. However, both experiments that go beyond dryout and applications to accident sequences in which the debris proves uncoolable, require either transient (rather than steady-state) modelling or a justification that steady-state results can be used in a quasi-transient manner. Further, the time to dryout and the location of the first dried-out region are parameters that can be measured in experiments, and provide validation (or otherwise) of the model, if sufficient transient terms have been retained. This paper presents generalizations of the transient model first discussed by Turland and Moore. Because of the different mathematical forms of the equations, which lead to the choice of differing analytic and/or numerical techniques the authors retain the distinction of Turland & Moore between models with and without capillary pressure. To take full advantage of the transient modelling it is necessary to be able to extend calculations beyond dryout. This is discussed in the paper where results using an enthalpy formulation are presented.

45913 (EPRI-NP—4455, pp 7.1-7.8) **Scale effects and structure of dryout zone in debris bed coolability experiments.** Hu, K.; Theofanous, T.G. (Purdue Univ., West Lafayette, IN). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

This paper presents the second and third rounds of experimental data from Purdue's Large Scale Debris Bed Coolability Simulation Facility. This facility employs a novel experimental technique for creating a volumetrically (or quasi-volumetrically) heated bed of arbitrary dimensions. These dimensions are only limited by available DC or AC power. In the current setup a variable 100 kw DC power generator is employed for a cylindrical bed 101.6 cm in height and 21.6 cm in diameter. The present bed was assembled by layering the coiled, and threaded by 1.27 cm aluminum balls, resistance heaters with 8 mm nominal dimensions stone gravel. A total of 240 thermocouples are placed throughout the bed and are scanned at 5 s intervals using PDP-11 computer and associated multiplexing equipment. This experimental effort is motivated by the total lack of coolability limit data in the very deep beds of large ($d > 3$ mm), irregularly shaped particles of interest in LWR severe accidents analyses.

45914 (EPRI-NP—4455, pp 8.1-8.10) **Experimental studies of dryout during boiling in particle beds at AEE Winfrith (UKAEA).** Stevens, G.F. (Winfrith Atomic Energy Establishment, Dorchester, England). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

This paper outline recent experimental work on particle bed dryout at AEE Winfrith. Progress has been made in developing dielectric heating for particle beds. This heating method is a good simulant for decay-heating when the particles are irregular, as in the case of reactor core disruption accidents in LWRs. The electrical resistance heating method has been used to study the effects on dryout heat flux of increasing the operating pressure from 1 bar to 9 bar. An examination of the relationship between flooding and dryout in beds of large particles has been made.

45915 (EPRI-NP—4455, pp 9.1-9.23) **Dryout of a multidimensional porous bed.** Tsai, F.P.; Catton, I. (Univ. of California, Los Angeles). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Coolability of a heterogeneous debris bed resulting from a hypothetical severe LWR or LMFBR accident was studied both experimentally and analytically. The debris bed was modeled with stainless steel spheres of diameters 1.6, 3.2, and 4.8 mm. Freon-113 and methanol were used as coolants. The dryout heat flux in the bed of heated steel spheres was found to be much higher than a similar homogeneous bed. The amount of increase was found to depend strongly on the geometry of the bed.

45916 (EPRI-NP—4455, pp 10.1-10.9) **Coolability of UO_2 debris beds in pressurized water pools: DCC-1 and DCC-2 experiment results.** Reed, A.W.; Bergeron, E.D.; Boldt, K.R.; Schmidt, T.R. (Sandia National Lab., Albuquerque, NM). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—). Contract AC04-76DP00789.

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

DCC-1 and DDC-2 are first two experiments in the US Nuclear Regulatory Commission's (USNRC) Degraded Core Coolability (DCC) Program being performed at Sandia National Laboratories. The DDC program is part of the NRC's Severe Fuel Damage (SFD) program established after the accident at the Three Mile Island-2 reactor. The main objective of the DCC program is to verify, with a limited number of in-pile experiments, the accuracy of existing debris coolability models in previously untested SFD parameter regimes. The primary test matrix consists of three experiments, the first two of which are reported here. Both of these tested the coolability of a deep UO_2 debris bed in a pressurized water bath, with pressure varying from 1 to 170 atmospheres. The beds were fission-heated in the Annular Core Research Reactor to simulate the internal heat generation from decay heat in an SFD accident. DCC-3, to be performed in mid-1985, will be a similar experiment with the addition of bed stratification and liquid injection at the bottom of the bed.

45917 (EPRI-NP—4455, pp 11.1-11.10) **Geometrical radiation exchange factors for axial radiative transfer in an LWR core filled with absorbing-emitting gases.** Chan, S.H.; Cho, D.H. (Univ. of Wisconsin, Milwaukee). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The recent Three Mile Island accident has generated much interest in the thermal-hydraulic analysis of a light water reactor core that is uncovered and heated beyond the current design basis limit (2200°F). One of the major interests concerns the cooling capability of the uncovered rod bundles. In addition to convection by the gas mixture which comprises water vapor, hydrogen gas and fission products etc., thermal radiative transfer would have to be considered as it becomes increasingly important when the bundles get hotter. The evaluation of radiative cooling of the bundles, however, is complicated by several factors. Other than the complex physical geometry, the bundles are highly nonisothermal radially and axially. Thus radiative heat exchange should be considered, not only in radial direction but in axial direction as well. A reactor core filled with an emitting-absorbing mixture is considered. Analysis is provided to evaluate axial radiative heat exchange of a rod bundle with a nonuniform axial temperature distribution. The necessary radiation exchange shape factors between segments of the complex rod bundle arrangement are presented. They are applicable to arbitrary sizes of segments, well suited for numerical computations.

45918 (EPRI-NP—4455, pp 12.1-12.15) **Quenching by top flooding of a heat generating particulate bed with gas injection at the bottom.** Tung, V.X.; Dhir, V.K.; Squarer, D. (Univ. of California, Los Angeles). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Continued undercooling of the core of a light water reactor can result in severe degradation of the core material. In the degraded state, the core can form a heat generating debris bed. Successful quenching of such a debris bed must be accomplished before continuous cooling can be established. In this paper, experimental results on top quenching of a particulate bed with internal heat generation are reported. The effect of gas injection at the bottom was also examined. A model which included the effect of axial conduction is proposed to predict the quench front history and temperature variation in the unquenched portion of the bed.

45919 (EPRI-NP—4455, pp 13.1-13.15) **Transient quenching of superheated debris beds during bottom reflood.** Tutu, N.K.; Ginsberg, T.; Klein, J.; Schwarz, C.E.; Klages, J. (Brookhaven National Lab., Upton, NY). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Light water reactor degraded core accident sequence studies postulated the existence of superheated core debris beds within the reactor vessel. Indeed, results of the examination of the Three-Mile Island Unit 2 reactor suggest that a portion of the reactor core was fragmented into a solid debris bed. Thus from both the accident management viewpoint and the accident evaluation viewpoint, it is necessary to understand the quench characteristics of such a degraded core. Depending upon whether or not the bottom of the debris bed is completely blocked, the bed would either be cooled by an overlying pool of water or by the forced injection of the coolant from below. The physical and thermal state of the degraded core is most likely to be three-dimensional in nature. As a first step, however, in understanding this complex thermal-hydraulic behavior, the present work is concerned with studying the transient quenching of a physically homogeneous bed when the coolant is injected from below at a constant flow rate. Experimental and analytical modeling studies are discussed.

45920 (EPRI-NP—4455, pp 14.1-14.13) **Fluidization of a particulate bed during quenching by flooding from bottom.** Tung, V.X.; Dhir, V.K. (Univ. of California, Los Angeles). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Severe undercooling of a light water reactor (LWR) core can result in overheating of the fuel elements accompanied with an eventual loss of structural integrity. Under such a degraded state, the core debris may collect in the coolant channels in the form of a heat generating porous blockage. Before continued cooling of this heated porous layer can be established, complete quenching has to be accomplished. Experimental data have been obtained on quench front history and the magnitude of the pressure pulse which resulted in fluidization of the particulate bed during quenching by bottom flooding. A semi-theoretical model has been proposed to predict the magnitude of the initial pressure pulse. The model is found to compare reasonably well with the experimental observation.

45921 (EPRI-NP—4455, pp 15.1-15.10) **New interpretation on formation of UO_2 Post-Accident Heat Removal particulate in sodium.** Schins, H. (Joint Research Centre, Ispra, Italy). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

A comparative experimental study on quenching in sodium of four molten fuel materials, $UO_2Al_2P_3$, Cu and stainless steel, is presented. Experimental results like temperatures, pressures, particle shapes, particle size distributions, crack patterns and crystal grain sizes are given and interpreted. These fuel-coolant interactions (FCI) can be understood as all being characterized by transition boiling of sodium. The fuel is first fragmented by the sodium vapor bubble growth and collapse process. These particulates have smooth surfaces. The two materials, UO_2 and Al_2O_3, are fragmented further by a delayed mechanism which is thermal stress shrinkage cracking. Delayed particles are fragments of larger ones. Furthermore, attention is drawn to the theoretical results which show that pure FCI-particulate is significantly finer.

45922 (EPRI-NP—4455, pp 16.1-16.11) **Boil, a two dimensional model for boiling in an active particles bed.** Theunissen, P.H.; Bushlin, J.M.; Joly, C. (von Karman Institute for Fluid Dynamics, Genese, Belgium). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The present paper deals with the modelization of the 2D boiling in an active particles bed. A 2D steady state and isothermal model is assembled starting from the mass, momentum and energy conservation laws. The momentum balance includes capillary and gravity effects as well as two phase flow pressure losses. This physical description is implemented as a numerical code, named BOIL. One and two dimensional test cases are run to emphasize the effects of boundary conditions, heat source distribution, and relative permeabilities laws. Further developments are proposed for the BOIL implementation into a broader computer code (such as TORPEDO).

45923 (EPRI-NP—4455, pp 17.1-17.11) **Extended dryout and rewetting of small-particle core debris.** Barleon, L.; Thomauske, K.; Werle, H. (Kernforschungszentrum Karlsruhe, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

In the analysis of degraded core LWR accidents, the behavior of core debris has to be considered. This debris could be formed within the reactor vessel or in the reactor cavity, depending on the preceding accident history. There is generally an agreement, that the dryout limit is the most important parameter and correspondingly most work has been devoted to this topic. But the behavior after dryout (size and temperature distribution of dry zone) is also of interest because, if remelting of the fuel occurs, attack on and failure of the supporting structure is possible. On the other side, dry debris may be quenched by feeding in emergency cooling water. Steam generated during rewetting may cause pressure loadings on the primary system or on the containment and therefore the rewetting behavior is also important. In this work, the beds were composed of small, spherical stainless steel particles and water was used as coolant. Small particles are characterized by capillary pressure being comparable to the hydrostatic pressure. Extended dryout, especially the location, size and temperature distribution of the dry zone and the variation of these parameters with time and power density (down to rewetting) was studied with volume-heated beds. In addition, transient rewetting was investigated starting with a dry bed of uniform temperature.

45924 (EPRI-NP—4455, pp 18.1-18.9) **Coolability of UO_2 with downward heat removal the D10 experiment.** Mitchell, G.W.; Ottinger, C.A.; Meister, H. (Sandia National Labs., Albuquerque, NM). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—). Contract AC04-76DP00789.

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The Debris Coolability Program at Sandia National Laboratories (SNL) began in 1975 to investigate the coolability of particle beds which may form following a severe accident involving core disassembly in a nuclear reactor. The Debris Bed Experiments which comprise the program are conducted in the SNL Annular Core Research Reactor by fission heating fully enriched urania which is submerged in a sodium pool. The experiments provide

data which form the basis for the development of detailed phenomenological provide data which form the basis for the development of detailed phenomenological models. D10 is the first in the series to study the effects of bottom cooling which might be provided by structural materials onto which the reactor debris might settle in an accident condition. Additionally, it was designed to achieve temperatures in the debris approaching the melting point of UO_2 to investigate any change in coolability which might occur at those temperatures. These objectives were successfully met during the experiment, which was operated for a period of over 53 hours. Downward cooling was investigated under subcooled, packed bed and channeled bed conditions. Packed bed and channeled bed dryout powers were determined under several downward cooling conditions. Extended dryouts were established with maximum temperatures in the bed of 2500°C.

45925 (EPRI-NP—4455, pp 19.1-19.10) **Design features to enhance debris bed coolability.** Gabor, J.D.; Cassulo, J.C.; Pedersen, D.R. (Argonne National Lab., IL). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The use of appropriately designed (sculptured) layers of porous blocks fabricated from sintered shot that contain the debris bed and act as a device to enhance debris bed dryout has been experimentally and theoretically investigated. Experiments were conducted with a two-dimensional bed (11.1 mm thick by 305 mm wide by 150 mm high) of inductively heated 105 to 1000-μm stainless steel and nickel particles in water. Vertical columns of 3-mm glass balls within the metal particle bed enhanced the dryout heat flux. Dryout data for up to five 12.7, 25.4, 38.1, and 50.8-mm wide columns of the glass balls were compared with various modeling concepts. The dryout heat flux, in general, increased with column width and the number of columns. The Bubble Flow Model applied to parallel vapor flow within the glass-ball columns and debris bed gave the best agreement of the different models with the data.

45926 (EPRI-NP—4455, pp 20.1-20.9) **Penetration of a heated pool into a melting miscible substrate.** Eck, G.; Werle, H. (Kernforschungszentrum Karlsruhe, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Core-catchers have been proposed, which, after a core disruptive accident in a nuclear reactor, prevent containment failure caused by contact of the molten debris with the underlying ex-vessel structural materials. Most of these core-catchers are provided with sacrificial layers which on melting consume some fraction of the decay heat and dilute the heat sources and the fissionable material as the core masses are dissolved by the molten sacrificial material. Dilution of the core masses results in relatively low heat fluxes and temperatures at the wall of the core-catcher and, in addition, reduces the probability of recriticality. An experimental study was conducted on melting systems consisting of a liquid over-lying a solid substrate, which after melting of the solid, are mutually miscible. To initiate melting, the liquid was heated either by a planar heater from above or internally by an ac current. The density of the liquid was varied systematically, and it was found that downward heat transfer increases strongly with this parameter. In addition to heat transfer, mass transfer was studied by measuring the local concentration of the molten material in the liquid. A few experiments were performed in which sideward melting and two-dimensional pool growth were investigated.

45927 (EPRI-NP—4455, pp 21.1-21.10) **Modeling of core debris-sodium-concrete interactions.** Cheung, F.B.; Pedersen, D.R.; Nguyen, D.H. (Argonne National Lab., IL). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The interactions between sodium and concrete in the presence of heat-generating core debris resulting from a postulated core meltdown accident in a sodium-cooled fast reactor are complex yet important phenomena relevant to several key safety issues. In particular, the attack of sodium and of core debris on the concrete basemat below the reactor cavity, the generation of hydrogen gas, and the pressurization of the reactor building as a result of the interactions represent, among others, the major sources that provide a challenge to containment integrity. Thus far, no physical model has been developed to describe the nature and the extent of sodium-concrete interactions with core debris present. Most of the previous studies have been confined to either the case of core debris-concrete interactions without sodium or the case of sodium-concrete interactions without fuel. In the former case, the initial conditions are so defined that the chemical erosion phase is completely ignored. In the latter case, on the other hand, the long-term melt penetration process is not considered. The termination of the sodium-concrete reactions simply marks the end of the event. It is the purpose of this study to provide a complete physical description of the scenario involved in the core debris-sodium-concrete interactions, starting from the chemical erosion phase through the molten pool formation phase to the long-term melt penetration phase.

45928 (EPRI-NP—4455, pp 22.1-22.15) **Effects of the presence of core debris on the behavior of sodium-concrete reactions.** Nguyen, D.H.; Muhlestein, L.D. (Westinghouse Hanford Co., Richland, WA). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

In the event of a LMFBR reactor vessel melt-through, the core debris will likely be deposited at the bottom of the sodium pool, overlying the concrete surface of the reactor cavity. The mixture of products from sodium-limestone concrete reactions is in a liquid state at about 600°C. The core debris would sink into the reaction product layer, thereby providing an internal heat source, in addition to heat from chemical reactions. A situation of sodium-concrete reactions without core debris present could arise when a coolant pipe break takes place outside the reactor vessel. This paper compares the behavior of sodium-concrete reactions with and without core debris present inside the reaction product layer. The effects of variable decay heat intensity are also assessed.

45929 (EPRI-NP—4455, pp 23.1-23.14) **Thermal-hydraulic uncertainties affecting severe accident progression.** Haskin, F.E.; Behr, V.L. (Sandia National Lab., Albuquerque, NM). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

In this paper, the authors focus on thermal-hydraulic uncertainties associated with severe PWR accidents. It is hoped that the discussion will help identify analyses and experiments which could reduce the uncertainties. The topics covered include: PWR depressurization, extent of in-vessel hydrogen production, in-vessel steam explosions, mode of fuel discharge, steam spike, coincident steam spike and hydrogen burn, direct heating, debris coolability, core-concrete interactions, ignition and combustion, equipment survival, and risk perspective and conclusions.

45930 (EPRI-NP—4455, pp 24.1-24.10) **Natural circulation phenomena and primary system failure in station blackout accidents.** Nourbakhsh, H.P.; Lee, C.H.; Theofanous, T.G. (Purdue Univ., West Lafayette, IN). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The potency of high pressure steam natural circulation phenomena to redistribute decay heat within the primary system components during the LWR core post-dryout/premelt period has not be fully appreciated in the past. A simplified analysis is summarized first as a way of developing a feel for the order of magnitude of various effects. Some simple experiments of natural circulation within a partially volumetrically heated porous medium are presented to more concretely demonstrate the efficacy of natural circulation cells to penetrate deeply into a heated porous bed. This paper then concludes with a brief description of a numerical model including applications to this demonstration experiment as well as the

reactor conditions of interest. High pressure steam natural circulation phenomena can be responsible for redistributing the core decay power to all primary systems components that are accessible to form circulating loops with the core region. As a result the primary system boundary is expected to fail prior to core melting, and the so-called high pressure scenario would appear unlikely. The possible role of clad ballooning, and oxidation remains to be assessed before these conclusions can be applied to all possible variations of a Station Blackout (or other similar) accident.

45931 (EPRI-NP—4455, pp 25.1-25.10) **Depressurization of the primary circuit during a PWR-high-pressure meltdown accident.** Eyink, J.; Hassmann, K. (Aktiengesellschaft, Erlangen, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Accident scenarios leading to PWR core-meltdown under high pressure have been investigated. In a transient case, RPV-failure will occur after about five hours. Because of the immediate failure of the surrounding concrete structure the pressure peak within the reactor cavity is limited and will thus not endanger the RPV-support. Therefore, even a rapid depressurization will have no effect on the integrity of the containment. The long-term course of the accident is quite similar to LOCA-initiated core-meltdown scenarios loading to overpresurization of the containment after about 5 days. During the first time following RPV-failure, the distribution of hydrogen, air and steam is not homogeneous. Therefore the thermodynamic states differ from those achieved from one volume calculation.

45932 (EPRI-NP—4455, pp 26.1-26.14) **Impact of heat-generating debris on containment loading - an overview.** Squarer, D. (Electric Power Research Institute, Palo Alto, CA). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

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The contribution to containment loading by five sources was identified. These sources are: containment initial conditions when the primary system is breached, hydrogen combustion, direct containment heating, steam spike, steam explosion, and debris/concrete interaction. When a conservative evaluation indicates that a containment is not threatened by these sources no refinement of the calculation is needed. However, for those containments that are threatened, a best estimate evaluation is needed. A list of recommended additional research is suggested in order to be able to perform best estimate calculations. Most of the suggested items are unrelated to the category of debris coolability since this category is understood at present much better than any of the other suggested research topics.

45933 (EPRI-NP—4455, pp 27.1-27.3) **Analysis of severe accident phenomena using EXMEL, EXMEL-B and MELSIM.** Bisanz, R.; Schmidt, F.; Unger, H. (Institute fuer Kernenergetik und Energiesysteme, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

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Within the frame of international research on reactor safety issues various experimental and theoretical programs were initiated in order to investigate the behavior of fuel rods, bundle and core in uncovery transients. Accident scenarios are considered which lead to fuel damage. Theoretical contributions to research objectives require complex modeling and have to based on complex computer and software techniques. The modular program systems EXMEL (fuel rod analysis), EXMEL-B (bundle analysis) and MELSIM 3 (core analysis) are the result of approaches to such problems. The code systems have been applied to severe fuel damage experiments in the Power Burst Facility and the Projekt Nukleare Sicherheit (PNS) of the Kernforschungszentrum Karlsruhe, the core damage calculations for the TMI incident and in the frame of the German Risk Study, Phase B. The paper presents comparison results of the severe fuel damage experiments and calculations as well as results of the analysis of a high pressure core meltdown scenario.

45934 (EPRI-NP—4455, pp 28.1-28.12) **Progression of a PWR severe accident from core melt to cavity interactions.** Turland, B.D.; Morgan, J. (UKAEA, Abingdon, England). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The progression of a PWR severe accident sequence after vessel failure, and the loads that are then placed on the containment is dependent, at least in its details on the in-vessel part of the accident sequence. This will determine the mode and timing and vessel failure, the quantities of material that are subsequently released to the containment building and the location of debris (which influences its coolability). Currently mechanistically based models exist for the core heating phase and the early stages of core degradation, but there is a need for more mechanistic descriptions of the latter part of the in-vessel sequence than is available in published codes. In this paper the authors discuss the phenomenology of the accident sequence from the release of material from the core region to the onset of cavity interactions; the reactor under consideration is assumed to be large modern PWR of the SNUPPS type. Before debris can interact with the structures and water in the vessels lower head it must first interact with the lower fuel nozzles and the lower core plate; this is discussed in section 2. In section 3 the authors consider the question of whether vessel failure is likely to occur immediately after debris interaction with the lower core plate, or whether the debris is in the lower head for a significant time prior to vessel failure. For this latter scenario, models for heat transfer from the debris to the vessel are considered in section 4; section 5 is concerned with the failure of the vessel.

45935 (EPRI-NP—4455, pp 29.1-29.2) **Severe accident sequence analysis with respect to debris formation and coolability.** Mayr, P.; Bisanz, R.; Unger, H. (Institute fuer Kernenergetik und Energiesysteme, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Various computer codes have been developed to analyze the course of severe accidents and the physical phenomena involving EXMEL, EXMEL-B, MELSIM and KESS. The models shall be described briefly in the paper. The modular program system KESS2 is being developed in order to allow the analysis of the course of severe accidents in light water reactors. The present paper is dealing with the debris formation and coolability question during the course of severe accidents. Starting with the initiation of the accident, the consecutive events which may result in the formation of debris beds as well as the physical phanomena involved have been derived by means of an accident sequence analysis. The analysis reflects the cause-consequence relation of the essential physical phenomena in the order of their occurrence: quenching of fuel rods in the core; fragmentation of fuel rods and core structures due to quenching; fluidization of fragments due to the onset of ECC injection; effectiveness of the transport mechanisms within the porous medium (debris or rubble beds); and occurrence of dryout.

45936 (EPRI-NP—4455, pp 30.1) **Review of IDCOR effort.** Henry, R. (Fauske & Associates, Burr Ridge, IL). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

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The IDCOR program has addressed the major processes associated with severe core damage accidents, including hydrogen generation and combustion, steam explosions, rapid steam generation, debris coolability, core-concrete attack and the release of fission products to the environment. These issues have been addressed individually and representative models have been integrated into system analysis codes for both the BWR and PWR designs. The Modular Accident Analysis Programs (MAAP) provide an assessment of the overall primary system and containment response to postulated accident scenarios for a variety of designs. Through the

use of these integrated system codes, the major physical processes determining the fission product release to the environment, and hence the implications on public health and safety, can be determined. In this paper, these individual physical processes are reviewed and integrated system analyses are presented which demonstrate the influence of variations in the physical process models as well as in the accident sequence definition.

45937 (EPRI-NP—4455, pp 31.1-31.10) **Bubble-induced mixing of two horizontal liquid layers with non-uniform gas injection at the bottom.** Cheung, F.B.; Pedersen, D.R.; Leinweber, G. (Argonne National Lab., IL). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

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During a postulated severe core meltdown accident in an LMFBR, a large amount of sodium coolant may spill into the reactor concrete cavity. A layer of liquid products may form as a result of the sodium-concrete reactions. The liquid product layer, which is highly viscous and much heavier than sodium, separates the concrete from the sodium pool. In general, the downward transport of sodium through the liquid product layer to the unreacted concrete surface, which controls the rate of chemical erosion of the concrete, depends strongly on the agitation induced by gas evolution from the heated concrete. In this study, experiments were conducted to explore the effect of non-uniform gas injection on mixing of two horizontal mutually soluble liquid layers. The liquid in the lower layer was chosen to be more viscous and heavier than the liquid in the upper layer. To simulate the reactor accident situation, gas was injected at the bottom of the liquid-liquid system through a circular hole that covered only the center portion of the bottom surface of the lower liquid layer. The bubble-induced mixing motions were observed and the rate of mixing was measured for different hole sizes and various gas flow rates. The results of this study clearly show that the rate of gas injection is not the only parameter controlling the mixing of the liquid-liquid system. The effect of non-uniform gas injection is important at high gas flow rates. Within the present experimental conditions, the reduction in the overall mixing rate can be as large as a factor of three.

45938 (EPRI-NP—4455, pp 32.1-32.18) **Interfacial heat transfer between bubble agitated immiscible liquid layers.** Lee, M.; Kazeme, M.S. (MIT, Cambridge). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

In a postulated severe light water reactor (LWR) accident, the interaction of corium with the concrete reactor cavity is an important part of the accident analysis. The immiscible metallic and oxidic phases will be separated into two layers due to the large density difference. The interfacial heat transfer between these immiscible layers is important in characterizing the corium/concrete interaction. In this paper, the data on the surface renewal mechanism for heat transfer between bubble agitated immiscible liquid layers is reviewed. A modified version of Szekely's correlation is proposed. The predictions of the new correlation compare favorably with the experimental data of water/mercury and oil/wood's metal. A simple model based on the hydrodynamic stability of a liquid jet is proposed to model the conditions for bubble induced entrainment. The proposed model can predict the published experimental observation of entrainment in an oil/water system and not in a water/mercury system. By applying the model to corium/concrete interaction, it is concluded that the bubble induced entrainment would not occur in corium/concrete interaction.

45939 (EPRI-NP—4455, pp 33.1-33.7) **CORCON-MOD1 modelling improvements.** Corradini, M.L.; Gonzales, F.G.; Vandervort, C.L. (Univ. of Wisconsin, Madison). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

Given the unlikely occurrence of a severe accident in a light water reactor (LWR), the core may melt and slump into the reactor cavity below the reactor vessel. The interaction of the molten core with exposed concrete (a molten-core-concrete-interaction, MCCI) causes copious gas production which influences further heat transfer and concrete attack and may threaten containment integrity. In this paper the authors focus on the low-temperature phase of the MCCI where the molten pool is partially solidified, but is still capable of attacking concrete. The authors have developed some improved phenomenological models for pool freezing and molten core-coolant heat transfer and have incorporated them into the CORCON-MOD1 computer program. In the paper the authors compare the UW-CORCON/MOD1 calculations to CORCON/MOD2 and WECHSL results as well as the BETA experiments which are being conducted in Germany.

45940 (EPRI-NP—4455, pp 34.1-34.3) **Core melt - concrete interaction: status of the WECHSL code development and present results.** Reimann, M. (Kernforschungszentrum Karlsruhe, West Germany). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

The codes being under development and describing the phenomena of LWR severe accident concrete interaction with, to some extent, different physical modelling, are WECHSL, KAVERN, and CORCON. The principles of the WECHSL code are as follows: All experimental investigations indicate a rapid seggregation of the core melt interacting with concrete. The steel and the metallic zirconium still available from the melt down process within the RPV form the underlaying metal layer. The oxide layer with a lower density consists initially of molten fuel (UO_2) and the ZrO_2 oxidized by the zirconium-steam reaction during the melt down process. Energy can be internally produced by decay heat or by exothermic reactions. Energy is lost to the concrete and to the overlying environment by a variety of mechanisms. Moreover, energy can be exchanged between the molten layers. The latest results of WECHSL calculations for core melt accident scenarios are presented with respect to the melt front propagation into the concrete basemat, the pressure built up inside the containment, and the time dependent composition of the containment atmosphere.

45941 (EPRI-NP—4455, pp 35.1-35.14) **Containment pressure response to a meltdown condition of the light water reactor.** Kao, L.; Kagumi, M.S. (MIT, Cambridge). Mar 1986. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920205. (CONF-841174—).

From 5. information exchange meeting on debris coolability; Los Angeles, CA, USA (7 Nov 1984).

A one cell simplified containment pressure model is incorporated into the CORCON/MOD1 code in order to study the impact of different heat transfer correlations on the containment pressurization. The effect of heat absorbed in the containment concrete wall was also studied. The results show that the downward heat transfer is important in determining the concrete ablation rate, but the containment pressurization rate is not affected much for the cases studied. It is also shown that the heat conducted into the concrete wall is a very important inherent heat sink.

45942 **(JAERI-M—84-237) ROSA-IV large scale test facility (LSTF) system description.** (Japan Atomic Energy Research Inst., Tokyo). Jan 1985. 320p. NTIS (US Sales Only), PC A14/MF A01. File Number DE86703190.

The ROSA-IV Program's large scale test facility (LSTF) is a test facility for integral simulation of thermal-hydraulic response of a pressurized water reactor (PWR) during a small break loss-of-coolant accident (LOCA) or an operational transient. This document provides the necessary background information to interpret the experimental data obtained from the LSTF experiments. The information provided includes LSTF test objectives and approach, the LSTF design philosophy, the component and geometry description, the instrumentation and data acquisition system description, and the outline of experiments to be performed.

45043 (JAERI-M—85-027) Evaluation report on CCTF core-II reflood test C2-6 (Run 64). Effect of radial power profile. Akimoto, Hajime; Iguchi, Tadashi; Sugimoto, Jun; Okubo, Tsutomu; Murao, Yoshio; Okabe, Kazuharu. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 97p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703191.

In order to evaluate the effect of the radial power profile on the system behavior and the core thermal hydraulic behavior during the reflood phase of a PWR LOCA, a test was performed using the Cylindrical Core Test Facility (CCTF) with the flat radial power profile. The test was conducted with the same total core power as that of the steep radial power test C2-5(Run 63). Through the comparisons of the results from these two tests, the following conclusions were obtained: (1) The radial power profile in the core has weak effect on the thermal hydraulic behavior in the primary system except the core. (2) Almost the same differential pressure was observed at various elevations in the periphery of the core regardless of different radial power profile. The result suggests that the core differential pressure is determined mainly by the total power and the total stored energy rather than by the local power and the local stored energy. (3) The test results support the single channel core model with the average power rod used in the reactor safety analysis codes such as REFLA-1DS, WREM for the evaluation of the overall system behavior. (4) In the steep radial power test, the heat transfer coefficient in the central (high power) region was higher than that in the peripheral (low power) region. The tendency was not explained by the estimation with the heat transfer correlation developed by Murao and Sugimoto assuming that the void fraction was uniform in a horizontal cross section. It is necessary to study more the dependency of core heat transfer on the radial power profile in the wide core.

45044 (JAERI-M—85-029) Main Steam Line break experiment at ROSA III - RUN 953. 100% break with an HPCS failure. Kawaji, Masahiro; Suzuki, Mitsuhiro; Nakamura, Hideo; Tasaka, Kanji; Anoda, Yoshinari; Kumamaru, Hiroshige; Yonomoto, Taisuke; Murata, Hideo; Shiba, Masayoshi. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 204p. NTIS (US Sales Only), PC A10/MF A01. File Number DE86703184.

This report presents the experimental results of RUN 953, a 100 % Main Steam Line (MSL) break experiment performed at the ROSA-III test facility. The ROSA-III facility is a volumetrically scaled (1/424) system of a BWR/6 used for integral BWR LOCA simulation experiments. RUN 953 is one of several MSL break tests with a 100 % break located upstream of the main steam isolation valve (MSIV), and performed to investigate the effect of an HPCS failure on the system behavior. This test is characterized, just as in a reference MSL break test, RUN 952, by a relatively slower depressurization of the system due to a break flow of high mass quality in comparison with the recirculation line break tests. Continuous flashing of the fluid in the pressure vessel was observed and a decrease in the pressure vessel coolant level eventually led to the uncovery of the entire core at about 200 s after break. After the water level in the downcomer dropped to the L1 level, LPCS and LPCI were activated at 281 s and the core recovered quickly thereafter. The peak cladding temperature reached was 1004 K, which is 252 K higher than that obtained in RUN 952, a reference MSL break test with HPCS actuation logic. This test has demonstrated the importance of HPCS actuation in achieving early core recovery during an MSL break LOCA.

45045 (JAERI-M—85-037) BWR recirculation loop discharge line break LOCA tests with break areas of 50 and 100% assuming HPCS failure at ROSA-III test facility. Suzuki, Mitsuhiro; Tasaka, Kanji; Yonomoto, Taisuke; Anoda, Yoshinari; Kumamaru, Hiroshige; Nakamura, Hideo; Murata, Hideo; Shiba, Masayoshi; Iriko, Masanori. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1985. 248p. NTIS (US Sales Only), PC A11/MF A01. File Number DE86703185.

This report presents the experimental results of RUN 962 and RUN 963 in ROSA-III program, which are 50 and 100% break LOCA tests at the BWR recirculation pump discharge line, respectively. The ROSA-III test facility simulates a volumetrically scaled (1/424) BWR system and has four half-length electrically heated fuel bundles, two active recirculation loops, three types of ECCSs and steam and feedwater systems. The experimental data of RUN 962 and RUN 963 were compared with those of RUN 961, a 200% discharge line break test to study the break area effects on the transient thermal hydraulic phenomena. The least flow areas at the jet pump drive nozzles and recirculation pump discharge nozzle in the broken recirculation loop limitted the discharge flows from the pressure vessel and the depressurization rate in the 100 and 200% break tests, whereas the least flow area at break nozzle limitted the depressurization rate in the 50% break test. The highest PCT was observed in the 50% break test among the three tests.

45046 (NUREG—0853-Suppl.6) Safety Evaluation Report related to the operation of Clinton Power Station, Unit No. 1 (Docket No. 50-461). Supplement No. 6. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1986. 278p. NTIS, PC A13/MF A01 - GPO. File Number TI86901608.

Supplement No. 6 to the Safety Evaluation Report on the application filed by Illinois Power Company, Soyland Power Cooperative, Inc., and Western Illinois Power Cooperative, Inc., as applicants and owners, for a license to operate the Clinton Power Station, Unit No. 1, has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Harp Township, DeWitt County, Illinois. This supplement reports the status of items that have been resolved by the staff since Supplement No. 5 was issued.

45047 (NUREG—1048-Suppl.6) Safety Evaluation Report related to the operation of Hope Creek Generation Station (Docket No. 50-354). Supplement No. 6. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jul 1986. 82p. NTIS, PC A05/MF A01 - GPO. File Number TI86901577.

Supplement No. 6 to the Safety Evaluation Report on the application filed by Public Service Electric and Gas Company on its own behalf as co-owner and as agent for the other co-owner, the Atlantic City Electric Company, for a license to operate Hope Creek Generating Station has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is located in Lower Alloways Creek Township in Salem County, New Jersey. This supplement reports the status of certain items that has not been resolved at the time of the publication of the Safety Evaluation Report. This supplement supports the issuance of a full-power license to operate Hope Creek Generating Station.

45048 (NUREG/CR—3262-Vol.2) COBRA-NC: a thermal hydraulics code for transient analysis of nuclear reactor components. Volume 2. COBRA-NC numerical solution methods. Thurgood, M.J.; George, T.L.; Wheeler, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830. 59p. (PNL—5515-Vol.2). NTIS, PC A04/MF A01 - GPO. File Number TI86010442.

The COBRA-NC computer program has been developed to predict the thermal-hydraulic response of nuclear reactor components to thermal-hydraulic transients. The code solves the multicomponent, compressible three-dimensional, two-fluid, three-field equations for two-phase flow. The three fields are the vapor field, the continuous liquid field, and the liquid drop field. The code has been used to model flow and heat transfer within the reactor core, the reactor vessel, the steam generators, and in the nuclear containment. This volume describes the finite-volume equations and the numerical solution methods used to solve these equations. It is directed toward the user who is interested in gaining a more complete understanding of the numerical methods used to obtain a solution to the hydrodynamic equations.

45949 **(NUREG/CR—4255-Vol.3-No.1) Aerosol release and transport program. Semiannual progress report, October 1985-March 1986. Volume 3, No. 1.** Adams, R.E.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 47p. (ORNL/TM—9632-Vol.3-No.1). NTIS, PC A03/MF A01 - GPO. File Number TI86012504.

This report summarizes progress for the Aerosol Release and Transport Program sponsored by the Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, Division of Accident Evaluation, for the period October 1985-March 1986. Topics discussed include (1) Aerosol-Moisture Interaction Test (AMIT) experiments 5002 through 5006; (2) efforts to measure the aerodynamic shape factor chi during these experiments; (3) a development test for determining parameters for generating concrete aerosols; (4) data concerning water-vapor generation during plasma torch operation; (5) the use of the ideal gas law in calculating relative humidity; (6) initial comparisons of CONTAIN code results with experimental data for an iron oxide aerosol-steam experiment in the NSPP Facility; (7) pretest predictions using the CONTAIN code for LACE experiment LA-2.

45950 **(NUREG/CR—4587) Source Term Code Package: a user's guide (Mod 1).** Gieseke, J.A.; Cybulskis, P.; Jordan, H.; Lee, K.W.; Schumacher, P.M.; Curtis, L.A.; Wooton, R.O.; Quayle, S.F.; Kogan, V. (Battelle Columbus Div., OH (USA)). Jul 1986. 274p. (BMI—2138). NTIS, PC A12/MF A01 - GPO. File Number TI86901596.

As part of a major reassessment of the release of radioactive materials to the environment (source terms) in severe reactor accidents, a group of state-of-the-art computer codes was utilized to perform extensive analyses. A major product of this source term reassessment effort was a demonstrated methodology for analyzing specific accident situations to provide source term predictions. The computer codes forming this methodology have been upgraded and modified for release and further use. This system of codes has been named the Source Term Code Package (STCP) and is the subject of this user's guide. The guide is intended to provide an understanding of the STCP structure and to facilitate STCP use. The STCP was prepared for operation on a CDC system but is written in FORTRAN-77 to permit transportability. In the current version (Mod 1) of the STCP, the various calculational elements fall into four major categories represented by the codes MARCH3, TRAP-MELT3, VANESA, and NAUA/SPARC/ICEDF. The MARCH3 code is a combination of the MARCH2, CORSOR-M, and CORCON-Mod 2 codes. The TRAP-MELT3 code is a combination of the TRAP-MELT2.0 and MERGE codes.

45951 **(NUREG/CR—4624-Vol.1) Radionuclide release calculations for selected severe accident scenarios. Volume 1. BWR, Mark 1 design.** Denning, R.S.; Gieseke, J.A.; Cybulskis, P.; Lee, K.W.; Jordan, H.; Curtis, L.A.; Kelly, R.F.; Kogan, V.; Schumacher, P.M. (Battelle Columbus Div., OH (USA)). Jul 1986. 240p. (BMI—2139-Vol.1). NTIS, PC A11/MF A01 - GPO. File Number TI86901592.

This report presents results of analyses of the environmental releases of fission products (source terms) for severe accident scenarios in a boiling water reactor of the Mark I containment design. The analyses were performed to support the Severe Accident Risk Reduction/Risk rebaselining Program (SARRP) which is being undertaken for the US Nuclear Regulatory Commission by Sandia National Laboratories. In the SARRP program, risk estimates are being generated for a number of reference plant designs. The Peach Bottom 2 plant has been used in this study as an example of a Mark I BWR plant.

45952 **(NUREG/CR—4624-Vol.2) Radionuclide release calculations for selected severe accident scenarios. PWR, ice condenser design. Volume 2.** Denning, R.S.; Gieseke, J.A.; Cybulskis, P.; Lee, K.W.; Jordan, H.; Curtis, L.A.; Kelly, R.F.; Kogan, V.; Schumacher, P.M. (Battelle Columbus Div., OH (USA)). Jul 1986. 222p. (BMI—2139-Vol.2). NTIS, PC A10/MF A01 - GPO. File Number TI86901593.

This report presents results of analyses of the environmental releases of fission products (source terms) for severe accident scenarios in a pressurized water reactor with an ice-condenser containment. The analyses were performed to support the Severe Accident Risk Reduction/Risk Rebaselining Program (SARRP) which is being undertaken for the US Nuclear Regulatory Commission by Sandia National Laboratories. In the SARRP program, risk estimates are being generated for a number of reference plant designs. The Sequoyah plant has been used in this study as an example of a PWR ice-condenser plant.

45953 **(NUREG/CR—4624-Vol.3) Radionuclide release calculations for selected severe accident scenarios. Volume 3. PWR, subatmospheric containment design.** Denning, R.S.; Gieseke, J.A.; Cybulskis, P.; Lee, K.W.; Jordan, H.; Curtis, L.A.; Kelly, R.F.; Kogan, V.; Schumacher, P.M. (Battelle Columbus Labs., OH (USA)). Jul 1986. 90p. (BMI—2139-Vol.3). NTIS, PC A05/MF A01 - GPO. File Number TI86901589.

This report presents results of analyses of the enviromental releases of fission products (source terms) for severe accident scenarios in a pressurized water reactor with a subatmospheric containment design. The analyses were performed to support the Severe Accident Risk Reduction/Risk Rebaselining Program (SARRP) which is being undertaken for the US Nuclear Regulatory Commission by Sandia National Laboratories. In the SARRP program, risk estimates are being generated for a number of reference plant designs. the Surry plant has been used in this study as the reference plant for a subatmospheric design.

45954 **(NUREG/CR—4624-Vol.4) Radionuclide release calculations for selected severe accident scenarios. Volume 4. BWR, Mark III design.** Denning, R.S.; Gieseke, J.A.; Cybulskis, P.; Lee, K.W.; Jordan, H.; Curtis, L.A.; Kelly, R.F.; Kogan, V.; Schumacher, P.M. (Battelle Columbus Div., OH (USA)). Jul 1986. 167p. (BMI—2139-Vol.4). NTIS, PC A08/MF A01 - GPO. File Number TI86901590.

This report presents results of analyses of the environmental releases of fission products (source terms) for severe accident scenarios in a boiling water reactor with a Mark III containment. The analyses were performed to support the Severe Accident Risk Reduction/Risk Rebaselining Program (SARRP) which is being undertaken for the US Nuclear Regulatory Commission by Sandia National Laboratories. In the SARRP program, risk estimates are being generated for a number of reference plant designs. The Grand Gulf plant has been used in this study as an example of a Mark III plant.

45955 **(NUREG/CR—4624-Vol.5) Radionuclide release calculations for selected severe accident scenarios. PWR, large dry containment design. Volume 5.** Denning, R.S.; Gieseke, J.A.; Cybulskis, P.; Lee, K.W.; Jordan, H.; Curtis, L.A.; Kelly, R.F.; Kogan, V.; Schumacher, P.M. (Battelle Columbus Div., OH (USA)). Jul 1986. 156p. (BMI—2139-Vol.5). NTIS, PC A08/MF A01 - GPO. File Number TI86901591.

This report presents results of analyses of the environmental releases of fission products (source terms) for severe accident scenarios in a pressurized water reactor with a large dry containment. The analyses were performed to support the Severe Accident Risk Reduction/Risk Rebaselining Program (SARRP) which is being undertaken for the US Nuclear Regulatory Commission by Sandia National Laboratories. In the SARRP program, risk estimates are being generated for a number of reference plant designs. The Zion plant has been used in this study as an example of a large dry containment PWR design.

45956 **(ORNL/CSD/TM—231) Adjoint-based sensitivity analysis for reactor safety applications.** Parks, C.V. (Oak Ridge National Lab., TN (USA)). Aug 1986. Contract AC05-84OR21400. 236p. NTIS, PC AA11/MF A01; 1; GPO Dep. File Number DE86014418.

The application and usefulness of an adjoint-based methodology for performing sensitivity analysis on reactor safety computer codes is investigated. The adjoint-based methodology, referred to as differential sensitivity theory (DST), provides first-order derivatives of the calculated quantities of interest (responses) with respect to the input parameters. The basic theoretical development of DST

is presented along with the needed general extensions for consideration of model discontinuities and a variety of useful response definitions. A simple analytic problem is used to highlight the general DST procedures. finally, DST procedures presented in this work are applied to two highly nonlinear reactor accident analysis codes: (1) FASTGAS, a relatively small code for analysis of a loss-of-decay-heat-removal accident in a gas-cooled fast reactor, and (2) an existing code called VENUS-II which has been employed for analyzing the core disassembly phase of a hypothetical fast reactor accident. The two codes are different both in terms of complexity and in terms of the facets of DST which can be illustrated. Sensitivity results from the adjoint codes ADJGAS and VENUS-ADJ are verified with direct recalcualtions using perturbed input parameters. The effectiveness of the DST results for parameter ranking, prediction of response changes, and uncertainty analysis are illustrated. The conclusion drawn from this study is that DST is a viable, cost-effective methodology for accurate sensitivity analysis. In addition, a useful sensitivity tool for use in the fast reactor safety area has been developed in VENUS-ADJ. Future work needs to concentrate on combining the accurate first-order derivatives/results from DST with existing methods (based solely on direct recalculations) for higher-order response surfaces.

45057 **(ORNL/TM—10094) Current status of decay heat measurements, evaluations, and needs.** Dickens, J.K. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014338.

Over a decade ago serious concern over possible consequences of a loss-of-coolant accident in a commercial light-water reactor prompted support of several experiments designed specifically to measure the latent energy of beta-ray and gamma-ray emanations from fission products for thermal reactors. This latent energy was termed Decay Heat. At about the same time the American Nuclear Society convened a working group to develop a standard for use in computing decay heat in real reactor environs primarily for regulatory requirements. This working group combined the new experimental results and best evaluated data into a standard which was approved by the ANS and by the ANSI. The primary work since then has been: (a) on improvements to computational efforts and (b) experimental measurements for fast reactors. In addition, the need for decay-heat data has been extended well beyond the time regime of a loss-of-coolant accident; new concerns involve, for example, away-from-reactor shipments and storage. The efficacy of the ANS standard for these longer time regimes has been a subject of study with generally positive results. However, a specific problem, namely, the consequences of fission-product neutron capture, remains contentious. Satisfactory resolution of this problem merits a high priority. 31 refs., 4 figs., 1 tab.

45058 **(SAND—84-1341) Development of ultrasonic thermometry for high-temperature high-resolution temperature profiling applications in LMFBR safety research.** Field, M.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1986. Contract AC04-76DP00789. 73p. NTIS, PC A04/MF A01 - GPO. File Number TI86013165.

Ultrasonic thermometry has been developed as a high temperature profiling diagnostic for use in the LMFBR Debris Coolability Program at Sandia National Laboratories. These instruments have been used successfully in the dc series experiments and the D10 experiment. Temperatures approaching 3000°C with spatial resolution of 10 mm and indicated temperature gradients of 700°C/cm have been measured. Instruments have operated in molten sodium, molten steel, and molten UO_2 environments. Up to 14 measurement zones on a single instrument in molten sodium have been used with 12 mm and 15 mm spatial resolution. Hermetically sealed units operated at elevated temperatures have been used. Posttest examination has revealed very little systematic calibration drifts (<10°C) with random drifts occurring with less than 40°C standard deviation in a 10 to 12 mm measurement zone. The stability of the system varies from +-1°C to +-15°C depending on the sensor design constraints for a particular application. Doped tungsten sensors have been developed to permit operation of total measurement zone lengths of 30 cm at temperatures above 2500°C. 33 refs., 13 figs.

45059 **(TPR-NS—27-No.1) Nuclear Safety technical progress review, January-March 1986. Volume 27, No. 1.** (Oak Ridge National Lab., TN (USA)). 1986. 158p. I. File Number TI85017984.

Separate abstracts were prepared for 6 papers in this report. (JDB)

45060 **Summary of the Knoxville International Topical Meeting on Fast Reactor Safety.** Levin, A.E. (Oak Ridge National Lab., TN). *Nuclear Safety;* **27**: No. 1, 1-13(Jan-Mar 1986).

This article reports on the International Topical Meeting on Fast Reactor Safety, held April 21-15, 1985, in Knoxville, Tennessee. The most recent in a continuing series of such conferences sponsored by the American and European Nuclear Societies, this meeting also had the support of the Atomic Energy Society of Japan; the International Atomic Energy Agency; and numerous research, industrial, and government organizations in the United States. The emphasis of the meeting was on the design and operational aspects of fast reactor safety, reflecting the movement away from concentration on severe accidents that has occurred internationally over the last several years. More than 200 persons from the United States, Europe, and Asia attended the conference, at which over 120 papers were presented, including comprehensive reviews of fast reactor safety programs in the United States, Japan, France, the Federal Republic of Germany, and the United Kingdom.

45061 **Analysis and evaluation of recent operational experience from the Fort St. Vrain HTGR.** Moses, D.L.; Lanning, W.D. (Oak Ridge National Lab., TN; Nuclear Regulatory Commission, Washington, DC). *Nuclear Safety;* **27**: No. 1, 58-67(Jan-Mar 1986).

The Nuclear Regulatory Commission's (NRC's) Office for Analysis and Evaluation of Operational Data (AEOD) has established an extensive program for screening, analyzing, and evaluating the operational experience data from all commercial nuclear power plants in the United States. This program is designed to provide feedback from field experience with actual operating events to NRC's continuing efforts to ensure the public's health and safety. Oak Ridge National Laboratory provides technical assistance to AEOD to evaluate the operating experience for Fort St. Vrain. The operating experience discussed includes notable safety-related events that have occurred since late 1981. Different events have been grouped according to the major plant system affected by the occurrence, including primary coolant system, electrical systems, and reactor building. 16 refs.

45062 **Energy and water development appropriations for 1987. Part 9. Hearings before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-Ninth Congress, Second Session.** Washington, DC; Government Printing Office (1986). 279p.

Part nine of the hearing record covers testimony pertaining to activities of DOE and the Nuclear Regulatory Commission (NRC). Seven witnesses from DOE, including representatives of the Richland and Savannah River facilities, testified on the safety of US reactors in response to concerns about the Chernobyl accident. At issue was whether US research or power reactors are vulnerable to a similar kind of accident. Witnesses noted DOE's safety record, its recent reviews of oversight procedures, and modifications to correct possible weaknesses in those procedures. Technical safety appraisals at Savannah River were made earlier than originally planned, and other studies will be conducted to ensure that design and engineering will minimize the possibility of an accident. NRC Commissioners and regulators testified at the second day of hearings to describe its efforts to understand what happened at Chernobyl and to outline the differences between the Soviet and US reactors.

45963 **S. 1225: a bill to amend the Atomic Energy Act of 1954, as amended, to establish a comprehensive, equitable, reliable, and efficient mechanism for full compensation of the public in the event of an accident... Introduced in the Senate of the United States, Ninety-Ninth Congress, Second Session, May 24, 1985.** Washington, DC; Government Printing Office (1985). 51p.

The Price-Anderson Act Amendments Act of 1986 amend the Atomic Energy Act of 1954 to improve the procedures for compensating the victims of accidents involving nuclear materials by DOE contractors or Nuclear Regulatory Commission (NRC) licensees. The purpose is to establish a mechanism that will be comprehensive, equitable, reliable, and efficient. The amount of financial protection required is the amount of liability insurance available from private sources, although the NRC may establish criteria for a lesser amount. The bill outlines new procedures for indemnifying contractors and prohibits punitive damages beyond the established liability.

25 ENERGY STORAGE

2501 Magnetic

45964 **Design and operating experience of an AC-DC power converter for a superconducting magnetic energy storage unit.** Boenig, H.J.; Nielsen, R.G.; Sueker, K.H. (Los Alamos National Lab., Los Alamos, NM). pp 772-778 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—).

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

The design philosophy and the operating behavior of a 5.5 kA, +.2.5 kV converter, being the electrical interface between a high voltage transmission system and a 30 MJ superconducting coil, are documented in this paper. Converter short circuit tests, load tests under various conditions, dc breaker tests for magnet current interruption, and converter failure modes are described.

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 45759

2506 Thermal

REFER ALSO TO CITATION(S) 45836, 46053

45965 **(EPRI-EM—4722) Market constraints for residential cool storage systems. Final report.** Asbury, J.G.; Giese, R.F.; Looney, Q. (QLA, Inc., Washington, DC (USA)). Jul 1986. 179p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920429.

Residential air conditioning represents a significant and growing component of peak demand met by the Nation's electric utilities. Shifting this demand into off-peak hours through the application of thermal energy storage offers technical appeal, but the economic implications are uncertain. The purpose of this project was to estimate the magnitude of utility cost savings which might be realized through shifting residential space cooling off peak, establish cost and performance goals for the cool storage equipment and set a rough minimum size for the residential cool storage market. These objectives were met through analyses of data and information obtained from the literature, through a workshop attended by utility personnel and equipment manufacturers and designers, and from 29 utility companies. Twenty-one of the participating utilities applied a simplified assessment methodology developed during this project and supplied to them on a computer disk suitable for the IBM-PC. The results indicate that a market for cool storage equipment of $650 million to nearly $3 billion in 1984 dollars over a 10-year period is possible. The lower end of this range, which represents a market of 327,000 units, would be expected to cut noncoincident demand by 958 MW and yield over $150 million in annual benefits to the surveyed electric utilities and their customers in 1993.

2509 Batteries

REFER ALSO TO CITATION(S) 46293, 46295

45966 **(N—86-25039) Principles for system level electrochemistry.** Thaller, L.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 13p. (NASA-TM—87283; E—2908; CONF-860913—2). NTIS, PC A02/MF A01.

From International power sources symposium; Brighton, UK (8 Sep 1986).

The higher power and higher voltage levels anticipated for future space missions have required a careful review of the techniques currently in use to preclude battery problems that are related to the dispersion characteristics of the individual cells. Not only are the out-of-balance problems accentuated in these larger systems, but the thermal management considerations also require a greater degree of accurate design. Newer concepts which employ active cooling techniques are being developed which permit higher rates of discharge and tighter packing densities for the electrochemical components. This paper will put forward six semi-independent principles relating to battery systems. These principles will progressively address cell, battery and finally system related aspects of large electrochemical storage systems.

45967 **(N—86-25046) Long life nickel electrodes for a nickel-hydrogen cell: cycle life tests.** Lim, H.S.; Verzwyvelt, S.A. (Hughes Research Labs., Malibu, CA (USA)). 1985. 14p. (NASA-CR—174815). NTIS, PC A02/MF A01.

In order to develop a long life nickel electrode for a Ni/H_2 cell, the cycle life of nickel electrodes was tested in Hi/H_2 boiler plate cells. A 19 test cell matrix was made of various nickel electrode designs including three levels each of plaque mechanical strength, median pore size of the plaque, and active material loading. Test cells were cycled to the end of their life (0.5v) in a 45 minute low Earth orbit cycle regime at 80% depth-of-discharge. It is shown that the active material loading level affects the cycle life the most with the optimum loading at 1.6 g/cc void. Mechanical strength does not affect the cycle life noticeably in the bend strength range of 400 to 700 psi. It is found that the best plaque is made of INCO nickel powder type 287 and has median pore size of 13 micron.

45968 **(SAND—86-7115C) Strength improvement in beta" alumina by incorporation of zirconia.** Heavens, S.N. (Sandia National Labs., Albuquerque, NM (USA); Chloride Silent Power Ltd., Runcorn (UK)). 1986. Contract AC04-76DP00789. 15p. (CONF-860968—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013575.

From 3. international conference on the science of technology of zirconia; Tokyo, Japan (9 Sep 1986).

Beta" alumina ceramic electrolytes for use in Na/S batteries are inherently weaker than most engineering ceramics due to the presence of weakly-bonded conduction planes in the crystal structure and to difficulties in controlling grain growth during firing. Substantial improvement in microstructural control is obtained by incorporation of m-ZrO_2 or PSZ, resulting in increases in strength and fracture toughness to around 350 MPa and 4 MPam/sup 1/2/ respectively. PSZ may adversely influence the electrical resistivity of the ceramic owing to the presence of impurities. With most zirconia powders a high level of retention of t-ZrO_2 is obtained at levels of addition up to 15% by weight ZrO_2. At these levels ZrO_2/β''-Al_2O_3 ceramics show low resistivity and stable resistance in Na/S cells.

45969 **Beta"-alumina solid electrolytes.** DeJonghe, L.C. (Lawrence Berkeley Lab.). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Sodium beta"-alumina is used as a solid electrolyte in high energy-density electrical storage batteries. A variety of degradation processes may limit the performance of the electrolyte. Factors af-

fecting rapid and slow degradation, including the effects of microstructure and of oxygen and water, are discussed. The results indicate that microstructural control and chemical purity should enhance cell life.

45970 **Ceramic electrolytes for energy storage.** DeJonghe, L.C. (Lawrence Berkeley Labs., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Ceramic sodium beta"-alumina solid electrolytes are used as ion-permeable membranes in sodium-sulfur cells. The factors that determine the successful, long-term operation of the electrolyte at 300 to 350°C are discussed. The most important elements for longevity of the battery are the control of the microstructure of electrolyte and the maintenance of chemical purity during cell operation.

45971 **Performance evaluation of nickel-cadmium cell separator material.** Timmerman, P.J. (Martin Marietta Corp., Denver, CO). pp 1.109-1.113 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The performance evaluation of a new aerospace quality nickel-cadmium battery cell separator material is crucial for the aerospace industry to accept a replacement for the diminishing supply of Pellon 250ML, the industry standard. Two ten cell groups of standard ten Ampere-Hour cells, containing Frudenburg 2117 and Pellon 2536 separator materials are being evaluated. Each ten cell group contains three cells utilizing Pellon 2505ML as the control. The Frudenburg group has completed receiving and characterization tests, and over 5000 accelerated LEO cycles at 40 percent DOD. The Pellon 2536 group is currently in characterization testing. The data gathered thus far on the Frudenburg cell group indicates marginally inferior performance compared to the Pellon 2505 control group. Early results suggest that the Pellon 2536 will be an acceptable separator material for aerospace applications. 11 references.

45972 **Mission and status of the U.S. Department of Energy's battery energy storage program.** Quinn, J.E.; Landgrebe, A.R.; Hurwitch, J.W.; Hauser, S.G. (DOE, Washington, DC; Battelle Pacific Northwest Labs., Richland, WA). pp 2.3-2.10 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

Attention is given to the U.S. Department of Energy's battery energy storage program history, assessing the importance it has had in the national interest to date in industrial, vehicular, and electric utility load leveling applications. The development status of battery technology is also evaluated for the cases of sodium-sulfur, zinc-bromine, zinc-ferricyanide, nickel-hydrogen, aluminum-air, lithium-metal disulfide, and fuel cell systems. Development trends are projected into the foreseeable future. 13 references.

45973 **Design and cost study of a 15 kWh hydrogen/nickel oxide battery for photovoltaic applications.** Sindorf, J.F.; Burant, L.J.; Dunlop, J.D. (COMSAT Labs., Clarksburg, MD). pp 2.177-2.184 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

A 7.5 volt (6-cell) 100 AH hydrogen-nickel oxide battery has been built which exhibits the potential for long cycle life and zero maintenance, characteristics similar to those of aerospace cells, but at a significantly lower cost. The approach used in the design of this battery was to incorporate, in a prismatic configuration, less expensive raw materials and fabrication processes to reduce manufacturing costs. In particular, the use of mass production techniques with economics similar to those used in the assembly of lead/acid SLI batteries were investigated.

45974 **Lithium/metal sulfide molten salt batteries: Present status and future potential.** Steunenberg, R.K. (Chemical Technology Div., Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL 60439). pp 320-326 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

Electrically rechargeable high temperature lithium-alloy/metal sulfide batteries with molten salt electrolytes are being developed, primarily for electric vehicle applications. The battery cells consist of Li-Al, Li-Si, or other similar negative electrodes, and positive electrodes containing iron or other metal sulfides as the active material. The current performance of such cells is summarized as a specific energy of about 100 Wh/kg at the 3-h discharge rate, a specific power of approximately 130 W/kg at 50% state of charge and a lifetime of 800-1000 cycles.

45975 **Polyacetylene batteries.** MacDiarmid, A.G. (Dept. of Chemistry, Univ. of Pennsylvania, Philadelphia, PA 19104). pp 31-35 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

Polyacetylene, (CH)/sub x/, the prototype conducting polymer, is the simplest possible conjugated organic polymer. It can be prepared by the polymerization of acetylene gas in the form of silvery flexible films whose conductivity can be readily increased by $\approx$12 orders of magnitude (from $\approx 10^{-9}$ to $\approx 10^{3}$ ohm^{-1} cm^{-1}) by controlled chemical or electrochemical oxidation or reduction. A number of studies during the past four years have demonstrated that polyacetylene and possibly other conducting polymers might serve as good electrode active materials in rechargeable storage batteries employing nonaqueous electrolytes. Neutral polyacetylene, partly oxidized polyacetylene, (CH^{+}/sup Y/A^{-}/sub y/)/sub x/, and partly reduced polyacetylene, [M^{+}/sub y/(CH^{-}/sup y/)]/sub x/, where A^{-} and M^{+} are monovalent anions and cations respectively, have been employed in various combinations both with themselves or with other anode- or cathode-active materials.

45976 **Advanced lead-acid batteries.** Bowman, D.E. (Argonne National Lab.). pp 19-22 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

The theoretical capacity of the PbO_2 active material (PAM) is 224 Ah/kg. In 1977, a typical Globe deep cycle battery would exhibit a specific energy of 29 Wh/kg or 59.5 Ah/kg AM. Years of research and development via the Argonne program resulted in substantially increasing the specific energy to 41 Wh/kg (77.2 Ah/kg PAM) with the successful design of an "Improved-State-of-the-Art" (ISOA) battery system. However, this represented only a 34.5% utilization of the positive active materials. The early development work on advanced battery systems required new approaches as the numerous electrical performance goals proved to be in design conflict with one another. It was soon apparent that it would be impossible to meet the goals if traditional design practices were incorporated. One of the more difficult challenges was to meet the extended cycle life requirements under a repetitive, deep depth-of-discharge (DOD) test regime (800 life cycles at 80% DOD).

45977 **High rate performance of a reserve lithium thionyl chloride multicell battery.** Garoutte, K.F.; Horning, R.J. (Honeywell Power Sources Center, 104 Rock Road, Horsham, PA 19044). pp 99-103 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

Progress in the high energy lithium thionyl chloride (Li/$SOCl_2$) technology has been such that reserve batteries employing this electrochemistry can now be called upon to fulfill applications previously specifying thermal batteries. These applications typically

demand reserve batteries having rapid rise time, high power capability, with operational life profiles extending from minutes up to one to two hours or longer. Typically, the longer life requirements, coupled with the undesirable heat associated with thermal batteries are the major factors which bring the $Li/SOCl_2$ reserve technology to the forefront. A 16-volt $Li/SOCl_2$ reserve battery using recent high power technology has been developed for Sandia National Laboratories by Honeywell Power Sources Center for employment in one such thermal battery application.

45978 **Research on lead dioxide: Recent results.** Varma, R. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). pp 197-200 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

Electrochemically active PbO_2 can be described as a defect solid. The defects are derived from incorporation of hydrogens in PbO_2 and the nonstoichiometry of the material. The relationship of the defect structure to the morphology of PbO_2 is not understood at the present time. The relationships of the defect structures to lead-acid positive plate capacity and cyclic performance constitute areas for future research.

45979 **Lead-acid battery negative: A review.** Mahato, B.K. (Johnson Controls, Inc., 5757 North Green Bay Ave., Milwaukee, WI 53201). pp 212-218 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

The negative electrode of a lead-acid battery has a lead alloy current collector and a high surface area, porous, spongy lead mass as active material. The developmental work on this electrode has remained limited partly because of the more pressing work needed to solve problems associated with the positive lead dioxide electrode, which for all practical applications except cold temperature and high rate discharge, limits the battery performance. More recently, because the lead-acid battery is being seriously considered for electric vehicle propulsion, solar energy storage and load-leveling applications under Department of Energy (DOE) sponsored programs, numerous attempts are being made to increase its energy density and cycle life. The weight of the negative electrode, which uses highly conductive lead as active material, is being reduced by decreasing the weight of the current collector grid and the active material; the former by grid design optimization and the latter by increasing the material utilization or mass reactivity. DOE has set as an objective for the advanced lead-acid battery to increase its energy density close to 60 Wh/Kg and cycle life to 1000 at 80 percent DOD per cycle. This review covers the lead electrode developmental work since 1970 with special emphasis on the (i) lead-plastic composite grid development, (ii) material utilization improvement, (iii) the effect of trace impurities, and (iv) failure processes.

45980 **Characterization of the surfaces of manganese oxides by water adsorption.** Fraioli, A.V. (Argonne National Lab., CMT 205, 9700 S. Cass Ave., Argonne, IL 60439). pp 147-150 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

The surface properties of a variety of synthetically prepared manganese oxides have been studied by water adsorption at 20°C. Isotherms were constructed from data obtained gravimetrically on samples equilibrated in airfilled humidistats. In each humidistat the partial pressure of the water vapor was fixed by the vapor pressure of a particular saturated salt solution. For samples activated in vacuo at 125°C, first layer adsorption exhibited strong physical or chemical bonding. Subsequent adsorption exhibited dominant Type III adsorption features characteristic of weak adsorbate/absorbent interaction.

45981 **Methods of electrolyte agitation and effects on the discharge and charge behavior of lead-acid batteries.** Tomantschger, K. (The Kenneth E. Johnson Environmental and Energy Center, Univ. of Alabama in Huntsville, AL 35899). pp 181-186 of Progress in batteries and solar cells. Volume 5. Shimotake, H. Cleveland, OH; JEC Press, Inc. (1984).

Several concepts for eliminating electrolyte stratification in conventional lead-acid batteries were tested by UAH. The system which proved to be the most promising is an air-lift pump retrofit system which can be attached from the outside of the battery. When operating the pump with air pulses, specific gravity differences in the top and bottom electrolytes can be avoided. The charge time is reduced, charge efficiency increased, and lifetime has been proven to increase. The water loss during charge declines. Using a battery with a thin separator, the flow is forced down along the plates and the discharge capacity was found to increase.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 45994, 46005, 46006, 46007, 46008, 46009, 46024, 46078

45982 **(EUR—10352-EN) EXODUS - a program for the economic evaluation of energy exchange opportunities in industrial sites. Final report.** Wouters, G.; Hermans, J.; Pastuer, E.; Wegener, W. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 144p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy.

The purpose of the present study is the development of a selection model allowing identification and evaluation of potential energy exchange and energy integration opportunities in existing industrial sites. The model gives a preliminary estimation of potential energy and cost savings for the companies involved. A selection and evaluation model has been developed and has been implemented on an IBM 4341/2 computer. The computer program EXODUS (Energy Exchange Opportunities in industrial Sites) has been conceived as a modular and interactive system. The validity of the EXODUS model has been demonstrated on three different pilot sites in cooperation with the companies involved and with local authorities. Special attention has been given to the testing of different data collection procedures. An on site data collection in combination with a general energy audit e.g. an energy bus audit is proposed as the most appropriate data collection procedure.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 45616, 45754, 45786, 45787, 45982, 45995, 45996, 45997, 45998, 45999, 46000, 46001, 46003, 46004, 46010, 46012, 46069

45983 **Imperfectly competitive equilibria in international commodity markets.** Kolstad, C.D.; Burris, A.E. (Univ. of Illinois, Urbana). *American Journal of Agricultural Economics;* 68: No. 1, 27-36(Feb 1986).

From AAEA annual meeting; Reno, NV, USA (27-30 Jul 1986).

The simple model of perfect competition in spatial markets has been widely applied in analyzing international agricultural trade. Yet, many markets do not appear to be perfectly competitive. This paper offers a new and efficient method for computing spatial equilibrium in oligopolistic or oligopsonistic markets. The authors apply the technique to an analysis of several hypotheses of market conduct in the international wheat market that have been put forward by other authors. They conclude that a Cournot-Nash duopsony model does not perform well in explaining trade.

45984 **Department of Energy posture hearing. Hearing before the Committee on Science and Technology, US House of Representatives, Ninety-Ninth Congress, Second Session, February 19, 1986.** Washington, DC; Government Printing Office (1986). 83p.

Energy Secretary John S. Herrington was the principal witness at a hearing held to review the DOE budget request for fiscal year 1987, the first year to feel the effects of the Gramm-Rudman-Hollings legislation. The DOE requests a 20% increase in weapons research funding and a 60% decrease in conservation programs and a 50% cut in fusion research activity. Committee members challenged the assumption that energy problems are no longer pressing

because of low oil prices, and suggested that the current lull presents an opportunity to prepare for the next crisis in energy supply and price. Herrington responded with an overview of the budget, which he described as lean and focused. Research funding emphasizes basic research and the need to overcome technological barriers, defederalization, and an open market approach.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 46012, 46675

45985 **(BNL—38299) Joint IAEA/UNEP/WHO project on assessing and managing health and environmental risks from energy and other complex industrial systems.** (Brookhaven National Lab., Upton, NY (USA). Applied Science Dept.). 1985. Contract AC02-76CH00016. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014184.

The project comprises four main activities, namely: (1) the development of a guide to procedures for risk management and hazard control, drawing on results from a number of case studies which will be carried out in Member States; (2) the establishment and operation of a system for the collection, evaluation and distribution of information concerning methods and, as required, health and environmental effects; (3) the training of personnel in risk management and hazard control; and (4) the promotion of an approach to risk management and hazard control, and procedures for the planning of energy production and use and of other complex technologies, at the national level. Each of these activities is described in detail.

45986 **(ORAU—262) Profile of criticality safety professionals in the Department of Energy contractor system.** Crowell, M.R.; Trice, J.L. (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1986. Contract AC05-76OR00033. 74p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014201.

Results are reported from a survey of 178 criticality safety professionals within the DOE contractor system. Data are presented on the group's demographics, work experience, areas of specialization, professional development, and use of ANS/ANSI standards and selected reference documents.

45987 **(PB—86-200151/XAB) Hazards: technology and fairness. Series on technology and social priorities.** (National Academy of Engineering, Washington, DC (USA)). 1986. 123p. NTIS, PC A06/MF A01.

The papers in the volume define some important issues in hazard management that are emerging during our national reexamination of environmental policies. Authors have identified three principal themes that resonate throughout current public debate about technological hazards. Part 1 addresses the question of how to regulate hazards--those arising from chronic, low-level exposures and from high-consequence hazards. Part 2 presents articles in hazards equity, compensation, hazardous waste facility siting and hazard compensation. Part 3 presents a set of practical lessons and cautions about managing hazardous technologies.

45988 **(PB—86-203056/XAB) Report to congress on injection of hazardous waste.** Salazar, M.; Kardon, G. (Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water). May 1985. 286p. NTIS, PC A13/MF A01.

In response to a directive from Congress, expressed in Section 701 of the Hazardous and Solid Waste Amendments of 1984, EPA obtained information on the engineering, hydrological, regulatory, and waste characteristics of hazardous-waste injection wells. Some of the general characteristics found were: There were 252 wells in 112 facilities of which 195 in 90 facilities were active in 1984; The injected volume of 181 wells which were active in 1983 was estimated at 11.5 billion gallons. Most of the injection occurs in the Gulf Coast and the Great Lakes Area.

45989 **Trends in environmental protection legislation in the USA and consequences for power plant design.** Dooley, B.; Baruch, S.B.; Miller, M.J. (Electric Power Research Inst., Palo Alto, CA, USA). *VGB Kraftwerkstechnik;* **66**: No. 5, 477-481(May 1986). (In German).

Environmental protection legislation in the USA has had far-reaching effects on the design and operation of fossil fuel-fired power stations. During the 1960s investigations specific to different elements have been undertaken into air, water and material independently of each other. With the formation of the Environmental Protection Agency in 1970 a long process of integration of the environmental protection laws on the one hand and of their implementation in power station construction on the other hand commenced. This trend has continued in the 1980s and the reduction of emissions of toxic substances forms an essential component of the consolidation of the environmental protection legislation. This paper describes the consequences of this progressive development and its effects on the design and operation of power stations in the future.

2904 Natural Resources

REFER ALSO TO CITATION(S) 45983

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 45991

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 45729, 45730, 45856, 45860, 45962, 45963

45990 **(DOE/EIA—0473(85)) Nuclear Power Plant Construction Activity, 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 13 Aug 1986. 61p. NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. File Number DE86014787.

Nuclear Power Plant Construction Activity 1985 presents cost estimates, chronological data on construction progress, and the physical characteristics of nuclear units in commercial operation and units in the construction pipeline as of December 31, 1985. This Report, which is updated annually, was prepared to respond to the numerous requests received by the Energy Information Administration for the data collected on Form EIA-254, "Semiannual Report on Status of Reactor Construction."

45991 **Nuclear technology transfer via standards: the OMB Circular A-119 in action.** Zapp, F.C. (Oak Ridge National Lab., TN). *ASTM Standardization News;* **14**: No. 2, 53-55(Feb 1986).

The Performance Assurance Project Office (PAPO) has 23 nuclear energy (NE) standards in some phase of conversion to the national consensus standards, and identified three new NE standards for possible conversion. The author describes the methods of developing a consensus for standards through the use of working groups and ballots and the process of adopting a standard. Voluntary NE standards categories cover operation, instrumentation and controls, equipment, programs and procedures, materials, electrical, and structures and building. 4 references, 2 tables.

45992 **Review of The Nuclear Connection.** Ball, S.J. (Oak Ridge National Lab., TN). *Nuclear Safety;* **27**: No. 1, 13-14(Jan-Mar 1986).

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 46107, 46108

45093 **(DOE/ET—11448-T1) External combustion steam injected gas turbine for cogeneration.** Norris, P.; Ford, D.; Meher-Homji, C.; Dixon, A. (Boyce Engineering International, Inc., Houston, TX (USA)). Jan 1980. 200p. NTIS $16.50.

A computer simulation of a Texaco entrained-bed coal-gasifier-fueled advanced (2400°F) gas turbine and heat-recovery steam turbine combined-cycle design analyzed the alternative control strategies during load-following maneuvers. Boyce Engineering studied the transient operation of this gasification/combined-cycle (GCC) plant to determine open-loop response as a stand-alone plant, as well as closed-loop response while functioning in a large interconnected utility network during specified operating contingencies. A cold-gas clean-up train with a Selexol physical absorption system removed up to 90% of the H_2S in the raw fuel gas produced from high-sulfur Illinois coal. Control was satisfactory in either gasifier-lead or turbine-lead mode. Supplemental fuel-gas storage was not required, but GCC plant fuel-gas pressure control to minimize pressure transients at the absorber column is recommended. In simulations, the GCC plant responded well and local controllers adequately maintained the GCC plant operation during typical variations in electric power demand and every emergency upset.

2910 Conservation

REFER ALSO TO CITATION(S) 46023, 46024, 46025, 46026, 46028, 46071

45094 (CONF-8508111—Vol.1, pp 15-23) **Practical care and feeding of evaluation.** Dethman, L.; Spinney, P. (Washington State Energy Office, Olympia). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

Over the past year and a half, the Washington State Energy Office (WSEO) has progressed from no systematic evaluation efforts and a negative view of evaluation, to a three-member evaluation team whose services are in demand throughout the agency and whose products are used by program and agency management. The process has been swift and not without pitfalls. This paper (1) discusses the practical lessons learned thus far from designing and implementing the evaluation program, and (2) gives an overview of how the authors have developed, implemented, and used computerized tracking systems. A companion paper in these proceedings gives the particulars on the development of the tracking systems, from hardware selection to specific software applications.

45095 (CONF-8508111—Vol.1, pp 26-35) **Comparative evaluation of six different energy conservation programs serving low income households in Massachusetts.** Nadel, S.M.; Sherman, M. (Massachusetts Audubon Society, Lincoln). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Massachusetts Executive Office of Communities and Development, (MEOCD) and the Massachusetts Audubon Society (MAS) evaluated six energy conservation programs operated by MEOCD through 29 local agencies. The study isolated energy savings attributable to temporary and permanent materials, heating system cleaning and tuning, burner replacement, standard weatherization as funded by DOE and other sources, and weatherization enhanced with HUD Solar Bank funds. The study found high savings and benefit-cost ratios for burner replacements (17.9% savings), and for standard and enhanced weatherization programs (21.2% and 40.7%, respectively). Lesser savings and benefit-cost ratios were attributable to temporary materials (7.7% savings), permanent materials (7.2% savings), and heating system cleaning and tuning measures (0.9% savings. The study found that homes receiving burner replacements and/or sidewall insulation had above average energy savings. Observation data and available references suggest that heating system tuning and infiltration reduction programs need improvement. The study reinforces MEOCD's recent decision to raise the expenditure ceiling for standard weatherization, as investments beyond the old ceiling proved to be very cost effective. 23 references, 2 tables.

45096 (CONF-8508111—Vol.1, pp 36-44) **Evaluation of Wisconsin's Low-Income Weatherization Program.** Hewitt, D.C. (Wisconsin Energy Conservation Corp., Madison). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

A detailed evaluation was conducted of the Low-Income Weatherization Program operated by the Wisconsin Department of Health and Social Services. The purpose of this study was to: (1) develop recommendations for improving the administration of the DH and SS program; (2) establish guidelines for choosing the best weatherization strategy; and (3) measure energy savings in the DH and SS program, and identify characteristics associated with differences in savings levels. The report documented weatherization work completed and energy usage for 418 houses weatherized in 1982 and a 91-house control group. Overall heating energy savings, determined by using the Princeton Scorekeeping Method (PRISM), were on the order of 6% to 10%, or 80 to 130 therms a year. Typical investments were about $700 per house for materials, with total costs of about $2250 including materials, labor, program support and administration. About 70-75% of the occupants felt the program did a good job in weatherizing their homes. Field visits to 98 houses indicated a need for improved selection and application of weatherization measures. 2 figures, 1 table.

45097 (CONF-8508111—Vol.1, pp 45-54) **Evaluating weatherization options: a comparison of three service alternatives.** Kushler, M.G.; Witte, P.M. (Michigan Dept. of Commerce, Lansing). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

This paper presents the highlight results of a comprehensive study of alternative approaches to providing low-income home weatherization services in Michigan. Four distinct levels of weatherization service were examined: (1) the regular federal Low-Income Home Weatherization Assistance Program (WAP); (2) a reduced cost version of the regular program, focusing only on providing ceiling insulation of R-19, infiltration work, and water heater insulation; (3) a low-cost/no-cost program using local volunteers; and (4) a comparison group of low-income households not receiving weatherization services. Over 650 homes from throughout the state were involved in the study, which was conducted during 1983 and 1984 (using the winter of 1983/84 as the post-service heating season). The major results of the study are those pertaining to fuel savings. Homes in the regular group achieved a 14.7% gross reduction in space heat fuel use (weather adjusted), while those in the reduced-cost group achieved a 9.2% reduction. Homes receiving the low-cost/no-cost service demonstrated no significant change in space heat fuel use, while the no-service comparison group actually increased its consumption by 5.7% over the time period examined. 5 references, 5 tables.

45098 (CONF-8508111—Vol.1, pp 72-82) **Evaluation of a financial incentive program: the BPA Residential Weatherization Program.** Hirst, E.; Goeltz, R.; Keating, K. (Oak Ridge National Lab., TN). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

During 1982 and 1983, the Bonneville Power Administration (BPA) operated an interim Residential Weatherization Program (RWP) throughout the Pacific Northwest. Participating households received free home energy audits and financial assistance to help pay for installation of retrofit measures in their homes. Almost 104 thousand homes were retrofit during the two years that the program operated; BPA's program cost totaled almost $160 million. This paper summarizes the results of a comprehensive evaluation of the BPA program. The evaluation focused on the energy-saving ef-

fects of the program and on its economic costs and benefits. 11 references, 3 figures, 3 tables.

45999 (CONF-8508111—Vol.1, pp 83-92) **Tale of two programs: an application of the Princeton Scorekeeping Method to evaluate energy savings of two weatherization programs.** Airriess, E.; Newman, P.; Banerjee, A.; Goldberg, M. (Public Service Commission of Wisconsin, Madison). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

This paper compares the energy savings resulting from two low-income weatherization programs in the state of Wisconsin. One program uses prescriptive guidelines for the type of measures to be installed; the other requires that all measures meet a simple five year payback. Each program's energy savings were evaluated with the Princeton Scorekeeping Method in 1984 and 1985 to guide decisions in qualitative improvements to state weatherization efforts. The methodology and design employed in this study offer lessons to other energy conservation evaluators. 6 references, 7 tables.

46000 (CONF-8508111—Vol.1, pp 110-119) **Measuring conservation cost-effectiveness: a utility perspective.** Fox, E.W.; Kelly-Cochrane, D.R. (San Diego Gas and Electric Co., CA). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

California Utilities, the California Energy Commission (CEC), and the California Public Utilities Commission (CPUC) have devoted significant resources to develop an appropriate methodology for evaluating conservation and load management programs. A major milestone of this effort resulted in the Joint CEC/CPUC Standard Practice for Cost-Benefit Analysis of Conservation and Load Management Programs (CEC/CPUC, 1983). While the Standard Practice gave utilities a common methodological framework for measuring program impacts, it left many related issues unresolved. These issues include the appropriate evaluation perspective (e.g. the non participant vs. society), measuring program-induced energy savings, and valuing the external and intangible conservation/load management effects. This article first outlines the Standard Practice, and then discusses how San Diego Gas and Electric Company (SDG and E) has worked to resolve the significant cost-effectiveness issues with the Standard Practice framework. 5 references, 1 figure, 3 tables.

46001 (CONF-8508111—Vol.1, pp 120-129) **Creating supply through demand side programs: the Austin experience.** Dahlke, D. (City of Austin Resource Management Dept., TX). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The City of Austin established a 15 year goal of 553 MW of conservation and alternative generation energy supply in 1983. This paper discusses the planning and evaluation tools developed to integrate Austin's conservation and load management strategies into traditional supply-side utility planning processes. Those tools include: data bases on program participants; computerized planning and forecasting models; building energy analysis programs; and end-use metered program savings. For conservation and load management programs to be integrated into utility load forecasting and generation planning processes, they must undergo rigorous and sophisticated planning evaluation processes. Austin's programs have a 3 year track record with evaluations and energy savings analyses showing 31 MW of conservation generated supply. The results and projected savings of these programs were integrated into the Austin Electric Utility's forecast for the first time in 1985. 4 tables.

46002 (CONF-8508111—Vol.1, pp 130-139) **Evaluation procedures as part of program planning.** Clingerman, R.J.; Clements, A.M. (Houston Lighting and Power Co., TX). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

Utility-sponsored programs in the past were primarily marketing efforts. Levels of participation provided an accurate measure of their success. However, after the emergence of energy conservation programs, volume of participation alone was no longer a reliable indicator of success. Conservation programs encounter many conflicting forces. Using less of a product often requires a conscientious, sustained effort. Extraneous influences such as weather, pricing, etc. also mask the performance of these programs. Thus, many early attempts at evaluating conservation programs were based on little more than best guesses hidden behind that friendly but overworked facade - the engineering estimate. Accurately evaluating a myriad of conservation programs, each with specific goals, requires an integration of evaluation procedures into the planning phase of a project. This paper presents a method in which evaluation procedures evolve as a natural consequence of planning. 2 figures, 4 tables.

46003 (CONF-8508111—Vol.1, pp 148-154) **Lessons from a local government technical assistance program.** Dethman, L.F. (Washington State Energy Office, Olympia). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Local Government Technical Assistance (LGTA) Program assists local governments, Indian tribes, and special districts in identifying cost effective projects that save or produce energy, and helps them to overcome obstacles in implementing those projects. The Washington State Energy Office (WSEO) has operated the program since May 1982; it is jointly funded by the Bonneville Power Administration and the Department of Energy. Participants are selected in two rounds each year. To evaluate program success from the point of view of those served, representatives of 32 communities selected in Riybds 1, 2, and 3 (between July 1982 and August 1983) were interviewed by telephone during August 1984. Two other communities were not surveyed because they participated minimally in the program. Since most of the communities are still pursuing their LGTA projects, final energy savings outcomes of LGTA assistance cannot be determined. This study, then combines aspects of both process and outcome evaluation. Survey findings are the major source of program evaluation information, but review of program materials and discussion with program managers and staff allowed a fuller interpretation of findings and more practical recommendations.

46004 (CONF-8508111—Vol.1, pp 155-158) **Using soft data to supplement cost-benefit evaluations.** Densmore, B. (Center for Neighborhood Technology, Chicago, IL). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

In CNT's case, the survey results underscore the fact that institutional clients apparently value the program's role in bringing attention to facilities management issues. It may be that the consulting expertise and role modeling vis a vis any construction project is of special value to nonprofits because their staff generally lack experience in this area. Although energy savings is the first priority, it is clear that this side effect is an attraction to clients. It is also clear that CNT must either do a better job of selling those services that received a relatively low ranking or reduce the level of effort (and cost) now associated with them. An energy conservation program is a product which is sold to clients as a way to reduce (or avoid-increases in) energy costs. If/when energy costs stabilize, the incentives for participating in such programs decreases. Program managers thus need to become increasingly adept at targeting customer concerns and priorities. Programs that require too much in the way of technical expertise or initiative from clients are especially vulnerable to the disappearance of their market.

46005 (CONF-8508111—Vol.1, pp 160-169) **Timely evaluations: a method for undertaking and evaluating an energy conservation program in under one year.** Nadel, S.; Meyer, P. (Massachusetts Audubon Society, Lincoln). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Massachusetts Audubon Society (MAS) developed and tested a new method for measuring the energy savings attributable to specific energy conservation programs. With the MAS method, an evaluation can be completed in as little as three months. The method is well suited for monitoring oil-heated buildings. However, the method is not suited for monitoring programs where the quantity or quality of the weatherization work is likely to be influenced by the presence of monitoring instruments. The MAS method makes use of direct meter measurements of oil and gas consumption and on-site indoor/outdoor temperature differences. Weekly energy consumption and temperature data are recorded for four weeks before, and four weeks after weatherization. The data are analyzed using an analysis of variance statistical procedure. The application of the MAS method (and some variations on the method) to an evaluation of Massachusetts' low-income weatherization programs is discussed. Comparison of the MAS study to evaluation studies done with the Princeton Scorekeeping Method (PRISM) show the MAS method to be of comparable accuracy. 11 references, 3 tables.

46006 (CONF-8508111—Vol.1, pp 170-179) **Data quality considerations in using the PRISM program.** Dunsworth, T.S.; Hewett, M.J. (Minneapolis Energy Office, MN). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Princeton University PRISM program represents the current state of the art in computerized analysis of residential energy use data. It has been found to be quite user-friendly and to normally produce realistic and robust estimates, but the testing and production experience also shows that its results can be quite erroneous if insufficient attention is given to several crucial data quality issues. Each data set should ideally contain 12 monthly readings of gas or electric use over one heating season, though each of these standards can be relaxed somewhat. The authors used 10 to 16 months with few problems, but with periods of 8 to 9 months it becomes critical to have summer baseload use and midwinter peak use both represented for reliable results. Following analysis they further eliminated cases with regression R^2 under 95%, CV of NAC over 5%, undefined or extreme parameter standard errors, or certain typical parameter deviations (eg. reference temperature beyond the 50-70°F range or baseload near or below zero for a combined use account that should have a positive value). These standards can be modified for differences in reading frequency, heating fuel, geographic/climatic area, sample size, and intended use of the analysis. 7 references, 3 figures, 1 table.

46007 (CONF-8508111—Vol.1, pp 182-189) **Evaluation of the Massachusetts Energy Conservation Service.** Nichols, D. (Energy Systems Research Group, Boston, MA). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

In 1984 an evaluation of the Massachusetts residential conservation service program was conducted for the lead RCS agency, the Executive Office of Energy Resources. The EOER expected the evaluation to answer the following questions: What are the strengths and weaknesses of the present program and how can EOER develop additional RCS program elements to overcome the motivational and resource obstacles to greater penetration of conservation measures? The technical evaluation of the existing program included review of the audit instrument, participation in home energy audits, and extensive interviews with a panel of resource persons, including representatives of: (1) program managers for RCS program operators; (b) community groups in each service area; (c) professionals active in the field of auditing and conservation measure installations; (d) utilities, fuel dealers; and (e) financial institutions. The evaluation of feasible opportunities for program enhancement included reviews of customer surveys, extensive interviews with the panel of resource persons, and development of systematic information on the nature and results of a set of utility and community residential energy conservation programs.

46008 (CONF-8508111—Vol.1, pp 201-210) **Effects of a municipal energy audit program on electricity consumption in single-family residences.** Brambley, M.R.; Bard, J.S.; Dalemar, B.A.; Johns, M.C. (Washington Univ., St. Louis, MO). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

An evaluation of the effectiveness during the cooling season of the residential energy audit program of a small municipality in Missouri is summarized. Impacts of the program on both electricity consumption and conservation activity are statistically estimated by comparing appropriate quantities for treated test and untreated control groups. The study is used as an example of how such an evaluation may be done. Some of the problems encountered both in carrying out the evaluation and in interpreting the results are presented, and selected solutions and their significance are discussed. 5 references, 3 tables.

46009 (CONF-8508111—Vol.1, pp 211-219) **Evaluation consideration: confounding variables.** DiPasquale, J.S. (Missouri Dept. of Natural Resources, Jefferson City). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Missouri Division of Energy is currently engaged in an ongoing evaluation of one aspect of its Residential Conservation Service (RCS) Program. This paper briefly explains the purpose and methodology of the study, and then focuses on intervening variables that had to be considered to make the study a valid one. The manner in which the evaluation team dealt with each of several constraints is discussed.

46010 (CONF-8508111—Vol.1, pp 233-249) **Evaluating potential employment effects of community energy programs.** Tschanz, J.F. (Argonne National Lab., IL). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

Through conservation and the use of locally available resources, an energy management program would reduce the drain on the local economy because of imported fuels and would benefit from the dollars retained locally in increased economic activity and employment. This paper examines the estimates, made by five communities during energy planning projects, of dollars retained locally and potential employment effects. Each community included a variety of energy management options within its project, ranging from simple, inexpensive retrofit improvements in individual structures to technologically sophisticated community energy supply systems. Comparisons of the aggregate results show wide variations among the five communities. Some of these differences may be real and attributable to specific differences in local conditions and proposed programs. Other differences, however, arise from the various methods and assumptions used by the communities in making their calculations. This paper interprets the results of these community evaluations by comparing the methods and assumptions they applied. 15 references, 6 tables.

46011 (DOE/CE/65601—T1) **Integrated energy management planning process for local and regional government facilities: energy management process, data analysis, guidebook and workshops. Final report.** (Zachar/Burns Energy Associates, Inc., New York (USA)). 25 Jul 1986. Contract FG01-84CE65601. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86013331.

The project was conducted in two phases. The first phase was developmental; the second one was the delivery of training workshops using the developed products. (DLC)

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 45754

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 45729, 45730, 45860, 45962, 45963, 45984, 46003, 46071

46012 **Management and planning of energy/environment systems in the United States of America.** House, P. (Office of Technology Impacts, Dept. of Energy, Washington, DC). pp 182-200 of National perspectives on management of energy/environment systems. Foell, W.K.; Hervey, L.A. New York, NY; John Wiley & Sons, Inc. (1983).

Energy planning in the United States is clearly polynucleated. Given the ubiquity of energy use and the federal approach to problem solving, each center of interest addresses energy issues and also tends to develop individual methods for dealing with questions of energy policy. This results in a large number of energy models with different aims and capabilities. However, this chapter is limited to the models used by the US Department of Energy (DOE) for official planning purposes. This restricts the number of models considered, but the fact that the DOE has only been in existence since 1 October 1977 and was made up of several previously existing units means that the "official" models of the Department are still evolving. Consequently, the discussion will be limited still further to those models that were the official models of some of the organizations which constitute the present Department; specifically, the Project Independence Energy Systems (PIES) model of the former Federal Energy Administration (FEA), the Brookhaven National Laboratory (BNL) Modeling System of Energy Research and Development Administration (ERDA), the Strategic Environmental Assessment System (SEAS) of the Office of Environment, ERDA, and the model developed by the Stanford Research Institute (SRI) as part of ERDA's Market Orientation Program Planning Strategy (MOPPS) exercise.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 45616

46013 **Arctic energy opportunities: Perspectives on U.S. resources and development.** Frye, K.N. (U.S. Dept. of Energy, Washington, DC 20585). pp 785-790 of Ocean engineering and the environment (Conference record). Piscataway, NJ; IEEE Service Center (1985). (CONF-8511102—).

From Ocean '85; San Diego, CA, USA (12 Nov 1985).

The Arctic is one of the last energy frontiers, yet one with the greatest of opportunities – opportunities for massive new sources of energy, opportunities for imaginative technology, and opportunities for research cooperation. This paper presents the U.S. Department of Energy's (DOE) perspective on Arctic energy opportunities, the resources, development plans, and technical barriers. The paper outlines major U.S. policy areas and the Arctic programs of DOE and other U.S. agencies which are pursuing Arctic energy issues. Arctic energy development opportunities, particularly in the context of supportive research and cooperative efforts, are also discussed. These efforts, and enhanced international cooperation, may help solve Arctic development problems in a more efficient and timely way.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 46078

2960 Electric Power

REFER ALSO TO CITATION(S) 46000, 46001, 46002, 46008, 46023, 46026, 46028, 46071

46014 **(DOE/BP—696) Bonneville Power Administration forecast of electricity consumption in the Pacific Northwest. Executive summary.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Power Forecasting). Jul 1985. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014537.

This document presents a summary description of the Bonneville Power Administration 20-year forecast of electricity consumption in the Pacific Northwest for the years 1986 to 2006. This is the fifth year BPA has prepared a long-range forecast for use in meeting the agency's internal planning needs. The forecast consists of high, medium and low case sceanrios. By developing a range of load projections, BPA is better able to reflect the uncertainty inherent in the forecasting process. As in previous years, the final medium projection has been produced by merging serparate results from BPA's long-term and midterm forecasts.

46015 **(DOE/EIA—0095(85)) Inventory of Power Plants in the United States, 1985.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 8 Aug 1986. 295p. NTIS, PC A13/MF A01 - GPO; 1; GPO Dep. File Number DE86014788.

This document presents information about electric generating units operated by or planned to be operated by electric utilities in the United States and Puerto Rico. It presents statistics about electric generating units in operation by electric utilities, and a 10-year outlook of future generating unit additions by electric utilities, as of calendar year ended 1985.

46016 **(DOE/OR/00033—T202) Decision support for problems in which alternative actions affect downstream decisions, with an energy application.** Pumarada-O'Neill, L. (Northwestern Univ., Evanston, IL (USA)). Jun 1986. Contract AC05-76OR00033. 422p. NTIS, PC A18/MF A01; GPO Dep. File Number DE86014196.

Thesis.

Problems in which a present choice effects downstream decisions are usually solved informally or using decision analysis. Solving them requires considering the interactions of immediate alternatives with future decision-points. The hierarchical process proposed here is a formal approach which guides the decision-maker through a decision-structuring heuristic for solving multi-task problems. This process takes different forms for different problem structures, and according to which interacting decision-point was considered most important. The proposed methodology relies on pairwise analysis of sequential interactions. Although this process can be cumbersome in some contexts and it has a limited capacity for handling uncertain events, it is based on a methodology amenable to human decision-making and leads the decision-maker to a satisficing solution focused on the task considered most important. This thesis defines a general problem and focuses on a heretofore ignored subtype. After reviewing existing approaches to related types, it proposes a methodology for solving the featured problem. This methodology is evaluated, compared to related approaches, and applied to an electrical energy planning problem.

46017 **(EPRI-EL—4632-Vol.1) Integrated power system analysis package: scoping study. Volume 1. Industry survey. Final report.** Carlsen, K.; Fink, L.H. (Carlsen and Fink Associates, Inc., Fairfax, VA (USA)). Jul 1986. 132p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920425.

This project was undertaken to canvass the need for and the practicability of developing an integrated power system analysis ca-

pability that would accommodate existing widely used application programs, as well as new programs to be developed by EPRI and others, within an easy-to-use modular structure. The project included a mail survey of a large number of representative utilities, a series of follow-up on-site interviews with a selected sample of the respondents, and a study of the current state of the art in software integration within and beyond the electric power industry. The findings of this project are that integration of power system analysis software, properly defined, is indeed needed, that it is achievable within the present state of the art of software engineering, and that EPRI is an appropriate agent to undertake its development. The contemplated integrated capability will be modular, interactive, and evolutionary. It will be built upon an existing general purpose data base management system. It will include an initial core library of key applications programs. It will provide convenient and effective graphics and output analysis capabilities. It will enable the user to add to its library, at will and in a user-friendly manner, additional application programs of his own choice. It will be structured to permit implementation of expert systems techniques as they become practicable.

46018 **(EPRI-EL—4632-Vol.2) Integrated power system analysis package: scoping study. Volume 2. Software evaluation and integration. Final report.** Carlsen, K.; Fink, L.H. (Carlsen and Fink Associates, Inc., Fairfax, VA (USA)). Jul 1986. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920426.

A survey of more than 50 utility representatives found agreement on the need for an integrated analysis capability and on EPRI as a logical organization to develop the first computer code package. The findings revealed no technical obstacles but indicated costs and the need to learn new programs could hinder implementation. This volume documents the assessment of available software and provides recommendations.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 45786, 45787

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

REFER ALSO TO CITATION(S) 46823

46019 **(CONF-860663—1) Thermal radiation in MHD design applications.** Wang, C.S.; Chow, L.S.H. (Argonne National Lab., IL (USA). Magnetohydrodynamics Program). 1986. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014532.

From 24. symposium of engineering aspects of magnetohydrodynamics; Butte, MT, USA (24 Jun 1986).

The results of scale-up calculations on total gas emissivity from combustion gases containing carbon dioxide, water vapor, potassium atoms, and submicron-size slag particles are provided. A correlation equation to calculate total gas absorptivity and corrections to account for a gray surface are also presented. Measured data on the temperatures and emissivities of a surface covered with seed-slag are also included. A significant effect of potassium atoms and slag particles on total gas emissivity (especially at higher temperatures) is concluded. These calculated data, based on partially validated theoretical models, are approximate for MHD design applications and are presented in a form suitable for use by a design engineer. 14 refs., 8 figs., 1 tab.

46020 **(DOE/ID/01745—T10) [Mountain States Energy Division, Inc.] Quarterly technical progress report, April 1-June 30, 1986.** (Mountain States Energy, Inc., Butte, MT (USA)). 1986. Contract AC07-78ID01745. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014379.

This technical progress report presents the tasks accomplished at the Component Development and Integration Facility during the third quarter of FY86. Areas of technical progress included: Coal system development; test bay modification; seed system development; channel power dissipation and distribution system development; independent test activities; coal-fired combustor (CFC) nozzle project; materials testing; combustion characterization measurement; CFC support; 1A channel refurbishment; and test operations and results. Power test train operations were reinitiated in May. Tests completed for the baseline conductivity/power test series and the MHD seed characterization test series are detailed in Table 1. Major test operation accomplishments included: (1) Generating peak power of 1.51 MWe, which represents the highest diagonal power generated with the CFC and equals the previous CFC Faraday peak power. (2) Successfully integrating 32 AVCO-supplied current control units into power train operations. (3) Injecting seed with coal into the CFC - part of the first objective of the MHD seed characterization test series. 7 figs., 1 tab.

3003 Thermoelectric Generators

REFER ALSO TO CITATION(S) 46120

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

3201 Buildings

REFER ALSO TO CITATION(S) 45692, 45994, 45995, 45996, 45997, 45998, 45999, 46000, 46001, 46002, 46003, 46004, 46005, 46006, 46007, 46008, 46009, 46010

46021 **(AERE-R—1723) Crystallographic texture: experimental geometry and defocussing correction.** Sheldon, B.E. (UKAEA Atomic Energy Research Establishment, Harwell). Aug 1984. 34p. Issuing Activity.

X-ray measurements of crystallite orientation distributions (crystallographic texture) have been performed at Harwell since 1975, and the results obtained have been invoked in attempts to describe the anisotropic behavior of bulk materials. Most of the data have been produced for zirconium alloys wherein the hexagonal-close-packed (h.c.p.) lattice imposes constraints upon polycrystalline aggregates which lead to their anisotropy. The details of the technique used at Harwell have not been well publicized, hence this paper attempts to identify the salient parameters and compare them with those used by other workers. Although the method is basically sound, certain areas of doubt have been identified and recommendations made as to their resolution.

46022 **(CONF-860901—1) Development of a major center for roof research in the United States.** Courville, G.E.; Huntley, W.R. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86008981.

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

The United States Department of Energy (USDOE) is building a major roof research facility at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, USA. The purpose of the facility will be to carry out research to enhance the thermal performance and durability of low-slope roof systems. The centerpiece of the facility will be an environmental chamber capable of testing up to 3.8 m square roof sections under conditions of temperature, humidity, rain, and uplift air pressures encountered throughout the United States. Other features of this facility will be apparatus for thermophysical and chemical bench testing and a strong mathematical modeling capability. The facility will be designated as a National Users Facility, that is, it will be available to researchers from industry, academia, and other government agencies on a priority basis. USDOE and ORNL will be assisted by an Industrial Review Panel in setting research priorities and arranging schedules. The Facility will be ready for use early in 1988. Facility design features and a preliminary schedule of experiments will be described in this paper.

46023 (CONF-8508111—Vol.1, pp 6-14) **Evaluating energy conservation regulations.** Shaffer, J.C. (Seattle City Light, WA). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

While electric utilities have been realizing energy savings through informational efforts, financial incentives, and regulations, evaluation of informational and subsidy programs has dominated published evaluation literature. Unfortunately, because of the unique characteristics of energy conservation regulations, evaluations of informational and subsidy programs may not be the best models for evaluations of regulatory programs. This study describes some of the special challenges encountered in evaluation of Seattle City Light's Residential Efficiency Standards. The discussion focuses on goals and objectives, data collection, measurement of electricity savings, and cost-effectiveness. Evaluation techniques and major findings from Seattle City Light's Residential Efficiency Standards: The First 18 Months are presented. 7 references, 3 tables.

46024 (CONF-8508111—Vol.1, pp 56-70) **PRISM: a standardized method for keeping score on energy saved in houses.** Fels, M.F. (Princeton Univ., NJ). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

The Princeton Scorekeeping Method, or PRISM, is a statistical procedure which uses available billing and weather data to produce accurate estimates of saved energy. Derived from simple physical principles, the method provides physical descriptors as well as a weather-normalized index of consumption for each house analyzed. The long-range objective is a standardized approach which is equally applicable to all fuels, and which can be used for a wide range of climates and building types. This report summarizes the scorekeeping methodology - its motivation, its current status, and needed areas of expansion. 6 references, 6 figures.

46025 (CONF-8508111—Vol.1, pp 93-107) **Real world application: field testing the value of house doctoring as an incremental conservation measure.** Engels, D.; Peach, H.G. 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

One-hundred and fifty before and after blower door tests and seventy-five house doctor applications were performed on a random sample of homes to test the incremental effect of house doctoring as a conservation measure in the Hood River Conservation Project. Current results provide perspective on characteristics of the Hood River housing stock indicative of infiltration, structural performance measures of air changes per hour (ACH), effective leakage area (ELA), and average annual consumption. Evidence on the effects of House Doctoring in Hood River is presented, as indicated by change in ACH, ELA, and KWH savings, accompanied by an assessment of the reliability of blower door measurement. Kilowatt hour savings are contrasted with five additional comparison groups in an experimental design. Household characteristics for homes that benefit the most and the least from this new retrofit procedure are profiled. 9 references, 5 figures, 3 tables.

46026 (CONF-8508111—Vol.1, pp 142-147) **Process evaluation and program design: two BPA residential weatherization programs.** Lerman, D.I.; Bronfman, B.H. (Evaluation Research Corp., Portland, OR). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

Between January 1982 and September 1983 the Bonneville Power Administration (BPA) funded a retrofit weatherization program for electrically heated homes in the Pacific Northwest, the Interim Residential Weatherization Program. In the winter of 1983-84, Evaluation Research Corporation (ERC) conducted a process evaluation of the Interim Program in which a number of problems came to light: communication bottlenecks between the BPA conservation program manager, the BPA area offices and participating utilities; delays in reimbursing utilities for payments to weatherization installers; and a perceived lack of willingness on BPA's part to incorporate utility perspectives into program design and contract modifications. The Interim Program was followed in October of 1983 by the BPA Long-Term Residential Weatherization Program. In the summer of 1984, ERC conducted a process evaluation of the BPA Long Term Program in which it was revealed that many of the problems identified earlier in the evaluation of the Interim Program and by BPA staff had been rectified; utilities were not longer uniformly critical of BPA's motives or of its responses to questions about technical specifications or contract interpretations; the great mistrust stemming from BPA's financial audit of the Interim Program had subsided; and utilities felt their needs were being addressed by BPA in program modifications achieved via negotiation. 1 figure.

46027 (CONF-8508111—Vol.1, pp 190-200) **Evaluation of an RCS program alternative: the Santa Monica Energy-Fitness Program.** Egel, K. (City of Santa Monica, CA). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

From May 1984 through May 1985, the City of Santa Monica operated an innovative home energy audit program designed to test alternative approaches to the federally-mandated Residential Conservation Service (RCS) Program, the program under which virtually all major utility companies in the nation have offered their customers energy conservation audits and recommendations since the early 1980's. The Santa Monica effort, known as the Santa Monica Energy Fitness Program, used new techniques designed to increase participation in the RCS Program by utility customers, particularly target groups, such as senior citizens, low-income residents, and renters of multifamily housing, as well as improve the energy savings achieved by participants. Of particular importance were the use of a door-to-door canvas as the primary means of offering the program to Santa Monica residents and the completion of direct service home energy audit, which includes the actual on-site installation of energy saving devices in the participant's home. This paper provides a summary of the unique elements of the Energy Fitness Program's approach and presents the preliminary results of the evaluation performed to measure the Program's effectiveness, particularly in terms of participation and energy savings. 1 reference, 4 tables.

46028 (CONF-8508111—Vol.1, pp 222-232) **Residential energy-efficiency program for Burlington Electric Department: research and development of a program design.** Sachs, B.; Hamilton, B.; Walsh, R.W. (The Memphremagog Group, Newport, VT). 1985. NTIS, PC AA11/MF A01. File Number DE86011425.

From 2. national conference on energy program evaluation; Chicago, IL, USA (19 Aug 1985).

This paper reports the results of an extensive review and analysis of evaluations of existing residential conservation programs for the purpose of recommending a program design to meet the needs of a small municipal electric utility. Based on the study, a proposal was developed for a comprehensive program consisting of four parts: (1) a 50% grant-50% loan program for building owners; (2) a free major weatherization program for low-income building owners; (3) a community-based education/low-cost measures installation program and (4) development of local building energy-performance standards. The project's significance to energy conservation program evaluation lies in its utilization of evaluations from a wide range of residential programs to develop recommendations specific to a particular community situation. 2 references, 1 table.

46029 (DOE/CE/30805—T1) **Robie House. Phase II report. Recommendations for cooling and ventilation, restoration of doors and windows, refrigerated cooling retrofit.** (Burt-Hill-Kosar-Rittelmann Associates, Washington, DC (USA)). 30 Apr 1986. Contract FG03-84CE30805. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014155.

The purpose of this effort is to provide the building owner, the University of Chicago, with recommendations for cooling. Natural ventilation is the preferred method as long as it can meet the needs of a modern office. This is especially attractive given the nat-

ural cooling design features mentioned by Frank Lloyd Wright scholars and confirmed by this research.

46030 **(DOE/SF/15774—T1) Weatherization assistance program. Final monitoring report for Arizona, California, the Navajo Nation, and Nevada.** (Stroud, Inc., Arvada, CO (USA)). Aug 1986. Contract AC03-85SF15774. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014699.

Stroud, Inc., was awarded a contract by the Department of Energy San Francisco Operations Office (DOE-SAN) to evaluate the weatherization programs for selected grantees and subgrantees in Arizona, California, the Navajo Nation, and Nevada. This final report summarizes both the findings and the recommendations that emerged from the forty (40) visits to grantees and subgrantees. The remarks are not intended to be detailed and exhaustive. Specific problems, achievements, and recommendations are to be found in the narrative reports. But some findings and traits are sufficiently general that they warrant being included in this final report. The recommendations reflect those general characteristics.

46031 **(LBL—11386) Ventilation cooling of residential buildings.** Kammerud, R.C.; Ceballos, E.; Curtis, B.; Place, W.; Andersson, B. (Lawrence Berkeley Lab., CA (USA)). Jun 1983. Contract AC03-76SF00098. 30p. (CONF-8401117—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013010.

From ASHRAE semi-annual meeting; Philadelphia, PA, USA (1 Jan 1984).

The effectiveness of ventilating residential buildings with unconditioned outdoor air as an adjunct to, or replacement for conventional vapor-compression air conditioning has been examined. The work reported was based on total energy analyses of a prototypical residential building in 24 locations throughout the continental United States. The energy analyses assumed fan-forced ventilation and examined the relative merits of various control strategies and various configurations of thermal mass within the building. Where possible, the results of these studies are extrapolated to conditions of natural ventilation. The primary conclusions are that: (1) ventilation has the potential to substantially reduce cooling energy use in the residential sector, (2) levels of thermal mass above those typically found in new construction enhance the effectiveness of ventilation and reduce peak energy use, and (3) to realize a significant fraction of the benefits of ventilation over conventional air-conditioning technology, effective means must be developed for exchanging heat with the external environment without allowing intrusion of moisture-laden air.

46032 **(LBL—17562) Total building impacts of south-facing roof apertures.** Andersson, B.; Adegran, M.; Albrand, P.; Kammerud, R.; Webster, T. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 9p. (CONF-840610—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013649.

From Windows in building design and maintenance conference; Gothenburg, Sweden (13 Jun 1984).

The US Department of Energy's Passive Experimental Non-Residential Buildings Program has resulted in the design, construction, and instrumentation of nearly twenty commercial buildings throughout the United States (Gordon 1982). Of these buildings, more than eighty percent employ south-facing roof apertures as a major component of their passive systems. These buildings provided an opportunity to investigate the impact of roof apertures with respect to such issues as occupant response to the naturally lit environment, effectiveness of electric lighting control, and secondary effects such as changes to the radiant and acoustic environments.

46033 **(PNL-SA—13260) Field measurements of cooling energy consumption in a multi-zone office building.** Heidell, J.A.; Taylor, Z.T. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1985. Contract AC06-76RL01830. 13p. (CONF-8509126—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011627.

From Hot humid climate conference; College Station, TX, USA (24 Sep 1985).

This paper discusses the cooling energy use in a small office building with the objective of developing an understanding of where energy is used and identifying relationships between cooling energy and other energy end uses. The goal is to translate this understanding into strategies for reducing cooling energy consumption in new buildings. The data presented in this paper are based upon empirical hourly end-use energy monitoring in a 20,500 square foot office building located in Richland, Washington. Hourly end-use energy and microclimate data have been collected for the past two years as a pilot metering project for a larger data collection effort in conjunction with the Commercial Building Energy Use and Design Program managed by Pacific Northwest Laboratory for the US Department of Energy.

46034 **(SERI/SP—273-2937) Passive solar manufactured buildings: design, construction, and class B results. Second edition.** Lane, R. (ed.). (Solar Energy Research Inst., Golden, CO (USA)). Jun 1986. Contract AC02-83CH10093. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86004440.

The Passive Solar Manufactured Buildings Program included twenty-six projects by twenty manufacturers. Eight of the projects were carried through all phases of the program: design, construction, and performance monitoring. These eight are presented in Part I and Part II of this report. The other eighteen projects progressed through the design phase, but were not constructed and monitored under the program. These projects are described in the Appendix.

46035 **(SERI/TP—254-2999) Measurement of effective thermal capacitance in buildings.** Subbarao, K.; Burch, J.; Hancock, E.; Jeon, H. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1986. Contract AC02-83CH10093. 16p. (CONF-851202—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86010725.

From DOE-ORNL-ASHRAE-BTECC conference on thermal performance of the exterior envelopes of buildings-III; Clearwater Beach, FL, USA (2 Dec 1985).

A short-term test method to measure the effective heat capacitance of a building is presented. The effective heat capacitance is defined in terms of the indoor temperature response to sinusoidal eat input; i.e., in terms of the thermal admittance. This definition is shown to yield a useful and measurable quantity, which can be related to a capacitance in a thermal circuit. A signal enhancement principle is introduced that allows accurate and repeatable measurements. the method is illustrated with data from a single family residence as well as a test cell. When additional mass was introduced into the test cell in the form of water containers, there was a well-determined change in admittance that agreed with expected change. Among the applications of this method are (1) diagnostics (measured versus calculated heat capacitance), and (2) a measurement-based characterization of heat capacitance effects of furnishings, for use in simulations.

46036 **Zone descriptions and response characterization for CLF/CLTD calculations.** Sowell, E.F.; Chiles, D.C. (Dept. of Computer Science, California Univ., Fullerton, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 179-200(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper presents the results of an extensive parametric study of the dynamic response of building cooling loads to heat gains. These results are in the form of tables that classify zones in terms of seven of their physical properties and according to their dynamic response characteristics. Weighting factors and other data are also given. The principal application of these results will be to allow calculation of tables of Cooling Load Temperature Differences (CLTDs) and Cooling Load Factors (CLFs) for a small number of representative zones that cover the wide range of zones found in practice. Additionally, they will allow for adjustment to the solar CLFs in the ASHRAE Handbook -1981 Fundamentals to account for carpets, room size, ceiling and exterior wall weight.

46037 **A direct-contact-charged direct-contact-discharged cool storage system using gas hydrate.** Carbajo, J.J. (Engineering Tech. Div., Oak Ridge National Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 258-266(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A cool storage system using a refrigerant gas hydrate as the storage medium and being direct-contact charged, direct-contact discharged is under development at Oak Ridge National Laboratory. A test facility has been built and was operated without any problem during either the charging or the discharging process. Some of the tests performed are described. At present, only refrigerant-12 has been used. Future plans include the use of other low-pressure refrigerants or mixtures of refrigerants that also form hydrates in order to reduce the total pressure in the system. A full-scale cool storage system is under design.

46038 **Dynamic modeling of combined thermal and moisture transport in buildings: Effects on cooling loads and space conditions.** Fairey, P.W.; Keresteciogiu, A.A. (Research and Development Div., Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 461-472(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A detailed, three-dimensional finite element model called Moisture Absorption and Desorption Analysis Method (MADAM) has been developed at the Florida Solar Energy Center (FSEC) to evaluate the moisture absorption and desorption rates of building envelopes and internal furnishings. The model has been validated against measured laboratory and field data. Moisture absorption and desorption correlations obtained through MADAM are then incorporated as a subprogram of Thermal Analysis Research Program (TARP). Mechanical system performance and building zone conditions are then evaluated on an hourly basis. MADAM/TARP analysis of residential cooling loads in humid climates shows that moisture absorption and desorption can have significant effects on air-conditioning loads and on indoor relative humidities. These effects are more pronounced when energy conservation strategies such as ventilation are used.

46039 **Fan pressurization of buildings: Standards, calibration, and field experience.** Gadsby, K.J.; Harrje, D.T. (Center for Energy and Environmental Studies, Princeton Univ., Princeton, NJ). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 95-104(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The fan pressurization method has been widely used by groups working with building retrofits and with new construction to evaluate the air tightness of building envelopes. To ensure uniformity in the testing method ASTM Standard E779-81 was developed. This standard is reviewed with commentary on practical aspects of its application. Calibration of the fan pressurization systems, often referred to as blower doors, will also be discussed, pointing out where calibration difficulties have arisen and the implications on field inspections. Use of fan pressurization together with infrared scanning is one of the best methods to pin-point air leakage sites in building envelopes. The applications of such methods in a variety of buildings will be discussed in order to demonstrate the utility of the methods in the evaluation of building tightness, including seasonal variations; effectiveness of envelope sealing; and the location of problem areas in the building envelope.

46040 **Aggregation of U.S. population centers using selected climate parameters related to building energy use.** Andersson, B.; Carroll, W.L.; Martin, M.R. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 183-205(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A technique for aggregating population centers into groups based on selected climate parameters is presented. Climate information on the 125 largest Standard Metropolitan Statistical Areas (SMSAs) in the United States (U.S. Bureau of the Census 1980) is used to assign each SMSA to a particular group. The technique selects on SMSA in each region as a "climate center," whose climate is used to represent the entire region. The 125 SMSAs contain over 140 million population and include every metropolitan area of 250 thousand or more. The climate variables used to group SMSAs of similar climate are heating and cooling degree days, K/subT/, a measure of solar radiation, and latent enthalpy hours, a measure of moisture that must be removed from outside air in order to bring it to a standard comfort condition. Climate information is derived from SOLMET and TMY weather data. Characterization of U.S. climates in terms of these variables and relationships between pairs of variables is discussed. An interactive agglomeration computer program, GLOM, aggregates the SMSAs into climate regions. The user provides aggregation rules based on specified ranges of the climate variables and a selection of initial climate centers. Considerable latitude is given to the user to manipulate and/or modify the computer-based groupings. The result is a series of SMSA groupings suitable for a wide variety of analyses in which climates with large populations can be evaluated using a minimum of representative centers for direct analysis. Statistical analysis is performed on each group to determine the population-weighted averages and ranges of climate parameters for SMSAs in the group and the relationship of each SMSA to group average climate characteristics and to the climate center of the group.

46041 **The laboratory evaluation of the heating mode part-load operation of an air-to-air heat pump.** Miller, W.A. (Energy Div. of Oak Ridge National Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 524-536(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The laboratory evaluation of the part-load Coefficient of Performance (COP) and capacity of an air-to-air heat pump were conducted in a parametric study of heat pump on-time, off-time, and outdoor ambient temperature. A split-system heat pump was instrumented and tested in the heating mode to gain better understanding of the physical processes of the cycling phenomena that degrade heat pump COP and capacity. Improvement in cycling COP and capacity was observed by controlling off-cycle refrigerant migration. Best cycling COP and capacity performance occurred for cycling tests conducted with refrigerant isolated in the indoor heat exchanger during the off-cycle, coupled with 2 min of extended indoor blower operating during the off-cycle. The analysis of loss per on and off cycle revealed refrigerant dynamics to cause appreciable time delays in establishing steady-state heat pump COP.

46042 **Off-cycle energy loss measuring methods for vented heating equipment.** Kweller, E.R. (National Bureau of Standards, Gaithersburg, MD). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 773-790(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Evaluations have been made of a possible alternative to the tracer gas test method now being used to measure off-period energy loss of space heating equipment with vent dampers. This alternative method offers the potential of a direct-measurement method without the need for expensive tracer-gas-type instrumenta-

tion. The method uses a controlled flow of gas to a small gas-fueled burner to simulate normal flue or stack temperatures previously measured during a cool-down test. Energy metered through the gas burner during the simulation gives a direct measurement of the thermal energy losses out of the stack. Results in comparison with the tracer gas method of test were lower for off-period energy loss measurements. A trend to better agreement between the two methods was noticeable for test furnaces with greater fuel input rates. Further development, testing, and evaluation will be required before the simulation can be considered as an acceptable alternative test method.

46043 Calculation of variable-base degree-days and degree-nights from monthly average temperatures. Sonderegger, R.; Cleary, P.; Dickinson, B. (Morgan Systems Corp., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 875-892(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The Computerized Instrumented Residential Audit (CIRA), a micro-computer building energy analysis program developed at Lawrence Berkeley Laboratory, uses a monthly variable-base degree-day method to calculate heating and cooling loads. The method's unique feature is its ability to model thermostat setbacks and storage of solar gain. The program accomplishes this by dividing each day into two periods, "average day" (8 a.m. to 8 p.m.) and "average night" (8 p.m. to 8 a.m.), with different base temperatures. For each mode (heating or cooling) and for each period (day or night), the program reconstructs degree-days as a function of average monthly day or night temperature using three empirical coefficients specific to the location. A comparison is made between degree-days computed from hourly weather tapes and those predicted using this method. The root mean square error between predicted and actual degree days is typically between 3 and 12 degree-days per month. Tables of the coefficients are given for over 150 locations in the United States, computed from hourly dry-bulb temperatures on TRY and TMY tapes. Seasonal predictions of heating and cooling energy budgets using this method show good correspondence to the DOE-2 hourly simulation method.

46044 Instrumentation for the in-situ measurement of building envelopes. Grot, R.; Modera, M.; Fang, J.B.; Park, H. (Building Physics Div., Center for Building Tech., National Bureau of Standards, MD). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1088-1100(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper discusses the types of instrumentation that can be used for the in-situ measurement of the thermal resistance of building components. Four types of instrumentation are described: non-contact spot radiometers, contact heat flow transducers, portable calorimeters, and a type of portable guarded hot plate device developed by Lawrence Berkeley Laboratories, called an envelope thermal testing unit. A brief description of each device is given along with a description of how the device is used to measure in-situ thermal properties of building components. A theoretical justification of the use of long-term averaging of the heat flow and temperature data for estimating the thermal resistance is also presented. The accuracy of each in-situ measurement method is accessed.

46045 Instrumentation for measuring moisture in building envelopes. TenWolde, A.; Courville, G.E. (USDA, Forest Service, Forest Products Lab., Madison, WI). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1101-1115(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper discusses moisture measurement instrumentation available or required for building research, together with some recent developments. The paper focuses on measurement of an in situ moisture content (MC) and humidity in buildings and building components. Electric resistance measurements have been most often used for this purpose. This method has the advantage of being relatively cheap, but many interfering factors limit the accuracy obtainable and the method is inherently intrusive. An alternative method, using capacitance measurements, is nonintrusive, provided that the area of interest is close to the surface. It is potentially less sensitive to interference from some extraneous factors, but at present it is difficult to use quantitatively. Both electrical methods face major problems because they assume a homogeneous distribution of moisture and because conducting material layers can greatly interfere. A promising technique is nuclear magnetic resonance, but currently it does not yield reliable quantitative results and involves complex and expensive apparatus. Relatively little is known about actual performance of instrumentation in buildings or building components. A survey of building researchers and others who could document their experience with various moisture measurement techniques would be very valuable. Development of a common evaluation procedure would also be helpful.

46046 Condensing coefficients when using refrigerant mixtures. Stoecker, W.F.; Kornota, E. (Univ. of Illinois at Urbana-Champaign, IL). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1351-1367(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

One factor affecting the attractiveness of using nonazeotropic refrigerant mixtures is the magnitude of the heat-transfer coefficient of the mixture in comparison to a single refrigerant. The heat-transfer coefficient should ideally be maintained as high as that of the single refrigerant in order to fully exploit other potential benefits of non-azeotropic mixtures. Research on condensing coefficients reported in this paper and elsewhere indicate a reduction in the coefficient when using a mixture. The principal reduction occurs in the midrange of the condenser. Photos and observations made on a glass-tube condenser indicate that the flow is stratified in this region. This finding suggests that it may be possible to prevent the reduction in the coefficient by installing turbulence promoters or circuiting the condenser to achieve higher velocities in this region of the condenser.

46047 Estimation of reference or balance point temperature. MacDonald, J.M.; Jung, L.; Tevepaugh, J.A. (Oak Ridge National Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1441-1449(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

For many years the energy performance of buildings has been estimated by using regression techniques involving energy use and heating degree day data. Recently, some techniques have emerged that use variable-base heating degree data to more closely characterize the energy performance of buildings. The base temperature used to calculate heating degree days is varied to match the reference or balance point temperature characteristic of the building being studied. This paper discusses (1) an iterative technique developed for estimating balance point temperatures, (2) concepts helpful in supplying this and other techniques to utility billing data for single-family residences, (3) limitations of the iterative technique, and (4) a comparison between whole-house and submetered heating data results. This work shows that estimates of annual heating energy use are not affected greatly but that estimated savings for some retrofits can be significantly affected by finding the correct balance part.

46048 Measured results of energy-conservation retrofits in nonresidential buildings: Interpreting metered data. Gardiner, B.L.; Piette, M.A. (Building Energy Data Group, Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1488-1500(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Most estimates of energy savings and cost-effectiveness of building energy conservation measures are based on engineering calculations or computer simulations. A compilation of utility billing data in occupied buildings is an important compliment to these estimates and provides feedback on building owners and operators on how well conservation retrofits work in practice. We have compiled energy consumption data on over 300 nonresidential buildings that have been retrofitted with energy conservation measures. For the 94% of the buildings in our sample that saved site energy, median savings were 31 kBtu/ft^2-year (350 MJ/m^2-year). In this paper, the authors discuss the benefits and limitations of using whole-building metered data to evaluate energy savings attributable to conservation measures. Submetered energy consumption data are scarce; they present examples and discuss the additional benefits such data can provide to the building operator in assessing the impacts of specific retrofit measures.

46049 **Flow around isolated structures and building clusters: A review.** Hosker, R.P. (Atmospheric Turbulance and Diffusion Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 1671-1692(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Buildings strongly perturb local wind fields and influence the transport and dispersion of air pollutants. Adequate predictive capability is generally not available; suspected problems are often treated on a case-by-case basis with wind tunnel and field studies. Retrofit solutions are frequently necessary. However, field and laboratory research has provided some limited guidance for estimating flow and dispersion near isolated buildings, near some building clusters, and in urban street canyons. This paper reviews the guidance available, and discusses some of the additional work needed to improve predictive capabilities. In particular, systematic study of flow and dispersion within building clusters is needed to determine mutual flow interferences and to estimate the optimum placement of fixed pollutant sources (e.g., stacks or vents) and receptors (e.g., air conditioning inlets) within building clusters. It is unlikely that detailed predictive models will be available for routine use in complex situations such as industrial facilities, but it may at least be possible to establish reasonable bounds for the individual situation. Reliable procedures cannot be expected until at least the simpler building cluster cases are better understood.

46050 **A modular computer simulation of absorption systems.** Grossman, G.; Michelson, E. (Technion Israel Institute of Technology, Haifa). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 1808-1827(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A modular computer simulation program for absorption systems has been developed, which makes it possible to simulate various cycle configurations. The user supplies information about operating conditions, as well as characteristics of the various subunits and working fluids of the system. In addition, he conveys to the computer an image of the cycle. Based on this information, the program calculates the temperature, composition, flow rate and pressure at each state point of the system and the heat quantities at each unit. The code is based on subroutines modelling each of the absorption system's units and a main program which links them up according to the user's specification. The program has been tested on single and double stage absorption heat pumps and heat transformers, with lithium bromide - water and water-ammonia as the working fluids. The results have been compared with experimental data from tests of LiBr-H_2O heat transformer, giving good agreement.

46051 **Influence of a surfactant additive on absorption heat pump performance.** Michel, J.W.; Perez-Blanco, H. (Research Section, Energy Div., Oak Ridge National Lab., TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 1847-1858(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Surfactant additives have been known for some time to influence the boiling characteristics of water and water-salt solutions. An enhancement of boiling heat transfer coefficients can be obtained by a proper choice of additives. When the capacity of an absorption heat pump is limited by its generator capacity and the generator is of the boiling-pool type, it is possible to increase the machine capacity by means of surfactant addition. In this paper, the preliminary experiments leading to the selection of a surfactant for a lithium bromide-water absorption heat pump are described. Minimum foaming was the most important consideration in this selection process. The measured machine performance shows that the generator capacity may be increased by values ranging from 5 to 10% of the original capacity. The actual value depends on the operating conditions as given by solution concentration, flow rate, and temperatures.

46052 **Building parameters and their estimation from performance monitoring.** Subbarao, K. (Thermal Research and Engineering Branch, Solar Energy Research Inst., Golden, CO). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 1886-1896(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper defines parameters that characterize the statics and dynamics of a building. A static parameter is the familiar building loss coefficient that one can calculate using element-by-element addition or determine from building performance data by regression. The dynamic parameters are obtained from a natural generalization of the static parameters. These parameters thus share the same characteristics. In this paper the authors define eight parameters for a one-zone building and give the results from actual performance data, pointing out extensions and applications. This method is referred to as BEVA (Building Element Vector Analysis).

46053 **Clathrates and conjugating binaries: New materials for thermal storage.** Tomlinson, J. (Oak Ridge National Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 1931-1937(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Clathrates and liquid conjugating binary systems form the basis for new latent heat materials under investigation as storage media for offpeak building heating or cooling. Clathrate compounds formed with water as a constituent are particularly attractive for this application, because they freeze at temperatures higher than ice but still low enough for effective building cooling. Partially miscible binary systems that possess a usable heat of mixing in the building heating/cooling temperature range have also been identified. These offer an advantage as thermal storage media in that they remain in liquid form. This paper describes clathrate and conjugating binary storage concepts curently being explored and discusses the technical and practical issues involved with each.

46054 **Documenting air movements and infiltration in multicell buildings using various tracer-gas techniques.** Harrje, D.T.; Duil, G.S.; Bohac, D.L.; Gadsby, K.J. (Center for Energy and Environment, Princeton Univ., Princeton, NJ). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* 91: No. 2B, 2012-2027(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Tracer gas techniques for measuring airflows in buildings fall into three categories -- dilution, constant injection, and constant concentration. Dilution of single tracer works well in buildings with a single zone and also in some two zone buildings. Multiple tracer gas measurements, necessary to characterize flows among more zones, are best conducted using the constant injection approach. The constant concentration method uses a single tracer gas to determine the air flow rates from the outside into each of as many as ten building zones. The paper outlines the different tracer techniques for making airflow measurements in multicell buildings and describes the operation of a constant concentration system. This system measures tracer gas concentration in different zones and injects accordingly to maintain a constant concentration in each zone. The system was tested in a single zone structure and successfully applied to a small three-zone house. Sensitivity analysis and calibration procedures described in this paper define the capabilities and limitations of this technique. Although this method does not fully characterize all interzone airflows in the building, it can be useful in analyzing the energy balance of multizone buildings. Additionally, these measurements can be used to evaluate the dilution of indoor air pollutants and the ventilation efficiency of buildings.

46055 **Energy performance analysis of fenestration in a single-family residence.** Sullivan, R.; Selkowitz, S. (Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 320-336(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper presents the results of a parametric study of a prototypical single-family ranch-style house. The DOE-2.1B energy analysis simulation program was used to analyze the variation in heating, cooling, and total energy requirements and resultant energy costs due to changes in the following building characteristics: fenestration orientation, size, conductance, and shading coefficient; and levels of internal heat gain, infiltration, and natural ventilation. Climatic sensitivity was established by considering results from Madison, Wisconsin, and Lake Charles, Louisiana. To facilitate simplification of the analysis, multiple regression techniques were used to generate a simplified algebraic expression that relates energy use to the parameters varied. This simplified representation of the performance data could form the technical basis for simplified design tools to define optimal fenestration configuration parameters.

46056 **A simple distribution method for two-dimensional temperature/humidity bin data.** Erbs, D.G.; Klein, S.A.; Beckman, W.A. (Carrier Corp., Syracuse, NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 413-426(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A distribution model is developed for relative humidity, and additional relationships are presented that allow the distribution model to be used on an hourly basis with either monthly-average daily relative humidity or monthly-average daily dry-bulb temperature and clearness index as the only meteorological data input. A procedure is described that allows the estimation of two-dimensional dry-bulb temperature/humidity ratio bin data from the distribution models for dry-bulb temperature and relative humidity. Comparisons of measured and estimated dry-bulb temperature/humidity ratio bin data are presented. A design method for the cooling load on a residential air conditioner is described, and air conditioning loads are calculated using both measured and estimated dry-bulb temperature/humidity ratio bin data.

46057 **Air leakage flow correlations for varying house construction types.** Kiel, D.E.; Wilson, D.J.; Sherman, M.H. (Dept. of Mechanical Engineering, Univ. of Alberta, Edmonton). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 560-575(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Fan pressurization techniques are being employed by an increasingly large number of contractors and auditors to determine the leakage characteristics of structures. In this study, a large data base of flow exponents and flow coefficients are compiled to determine the degree of correlation that exists between flow parameters. The resulting empirical relationships are then used to determine the feasibility of predicting these flow parameters directly from a single pressure difference test. On the basis of these correlations, a new pressure independent tightness parameter is proposed.

46058 **AC pressurization: A technique for measuring leakage area in residential buildings.** Modera, M.P.; Sherman, M.H. (Applied Science Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 120-132(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This report presents a new technique for measuring the leakage area of residential buildings. This technique, called AC pressurization, is designed to overcome most of the shortcomings of fan pressurization, the conventional technique for measuring leakage area. The fan pressurization technique (often performed using a blower door) has several known deficiencies: (1) the pressures it exerts on the building envelope are significantly higher than those experienced under natural conditions, thereby requiring extrapolation outside of the measurement range to calculate the leakage area; (2) it cannot make real-time leakage area measurements; and (3) the large volumes of air displaced by the fan can cause inconveniences such as large indoor temperature changes. AC pressurization, which induces sinusoidal pressure differences across the building envelope, can make real-time leakage measurements at low pressures without inducing large flows through the building envelope. The AC pressurization apparatus and analytical technique, as well as the laboratory measurements that determined the specifications for the field device are described herein. Field measurements of leakage area obtained with a prototype AC pressurization device are compared with those obtained by fan pressurization tests of six single family residences.

46059 **System design optimization and validation for single-speed heat pumps.** Fischer, S.K.; Rice, C.K. (Martin Marrietta Energy Systems). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 509-523(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Computer models for predicting the steady-state and seasonal performance of electric driven, air-source heat pumps are described. Laboratory data on the heating and cooling performance of two heat pumps (under steady-state conditions) are compared with model predictions. Measurements of the seasonal and annual energy consumption for an electric heat pump installed in an unoccupied home in Knoxville, TN, are presented and also compared with model predictions. A method for combining the steady-state and seasonal performance calculations and placing them under the control of a numerical optimization procedure is described. This combined code was used to determine the design of a heat pump which minimized annual energy consumption and yet met a design cooling capacity and had fan and compressor efficiencies and total heat exchange surface area comparable to one of the heat pumps used for the laboratory tests. The optimization results indicated a 16% reduction in annual energy consumptions but it was determined that about half of the energy savings was due to assumptions or the

steady-state calculations. The true energy savings were found to result from reduced fan powers and lower cycling losses. Similar analyses were performed for a central air-conditioner and a heat pump with idealized refrigerant flow control.

46060 **Field-measured cycling, frosting, and defrosting losses for a high-efficiency air-source heat pump.** Baxter, V.D.; Moyers, J.C. (Oak Ridge National Lab., TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 537-554(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

An air-to-air heat pump was installed in an unoccupied single-family residence and operated in a two-year test to characterize dynamic losses in capacity and efficiency due to cycling, frosting, and defrosting. During the heating season, defrosting losses were responsible for 10.2% of the total energy consumption (excluding supplemental electric resistance heating), frosting losses for 3.7%, start-up transient losses for 8.5%, and off-cycle parasitics for 3.3%. The heating cyclic degradation factor, C/sub d/, was estimated to be 0.26. Cooling mode steady-state performance of the heat pump was degraded from the manufacturer's ratings due most likely to a small refrigerant leak resulting in a slight charge deficiency. However, using the site measured performance as the steady-state base, it was found that start-up transient losses accounted for 2.8% of the total energy use and off-cycle parasitics for 4.4%. The cooling C/sub d/ was estimated to be 0.11 on this basis.

46061 **An optimized ground-coupled heat pump system design for northern climate applications.** Catan, M.A.; Baxter, V.D. (Brookhaven National Lab., NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1185-1201(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

This paper addresses the question of the performance of a ground coupled heat pump (GCHP) system with a water-source heat pump package designed expresaly for such systems operating in a northern climate. The project objective was to minimize the life-cycle cost of a GCHP system by optimizing the design of both the heat pump package and the group coil in concert. In order to achieve this objective, a number of modelling tools were developed to analyze the heat pump's performance and cost, and the ground coil's performance.

46062 **Multizone infiltration measurements in homes and buildings using a passive perfluorocarbon tracer method.** Dietz, R.N.; D'Offavio, T.W.; Goodrich, R.W. (Dept. of Applied Science, Brookhaven National Lab., Upton, NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1761-1776(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

A miniature passive perfluorocarbon tracer system was successfully applied to the determination of air infiltration and exfiltration rates from each zone of a multizoned structure, as well as the air exchange rates between zones in homes, multiple unit condominiums, naturally ventilated apartment buildings, and large commercial buildings with multiple air-handling systems. Use of the multizone technique in indoor quality assessments and air-handling system stratification studies appears to be quite feasible with the availability of this measuring system.

46063 **Errors resulting from the use of single-zone ventilation models on multizone buildings: Implications for energy conservation and indoor air quality studies.** D'Ottavio, T.W.; Dietz, R.N. (Brookhaven National Lab., Upton, NY). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1777-1792(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Errors resulting from treating a house as an enclosure surrounding a single, well-mixed volume of air are explored in detail for a ranch house with a basement. A fairly typical ventilation pattern is assumed, and three quantities--the air exchange rate, the indoor pollutant concentration from a given emission, and the energy required to heat infiltrating air--are calculated and compared using both the one-and two-zone models for this house. In general, the errors were around 10% to 20% if the basement was included in the one-zone models and 30% to 40% if the basement was neglected. Other factors that effect the magnitude of these errors include the length of a pollutant release, the outdoor temperature, and the air exchange rate measurement protocol, as well as the particular ventilation characteristics of the house.

46064 **Ventilation measurements in large office buildings.** Persily, A.K.; Grot, R.A. (Center for Building Technology, National Bureau of Standards, Gaithersburg, MD). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 488-502(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Ventilation rates were measured in nine office buildings using an automated tracer gas measuring system. The buildings range in size from a two-story federal building with a floor area of about 20,000 ft^2 (1900 m^2) to a 26-story office building with a floor area of 700,000 ft^2 (65,000 m^2). The ventilation rates were measured for about 100 hours in each building over a range of weather conditions. The results are presented and examined for variation with time and weather. In most cases, the ventilation rate of a building is similar for hot and cold weather. In mild weather, outdoor air is used to cool the building and the ventilation rate increases. In the buildings where infiltration is a significant portion of the total ventilation rate, this total rate exhibits a dependence on weather conditions. The measured ventilation rates are discussed in relation to the outdoor air intake strategy in each building. The ventilation rates are also compared to the design rates in the buildings and ventilation rates based on the ASHRAE Standard 62-81. Some of the buildings are at times operated at lower ventilation rates than recommended in Standard 62-81.

46065 **Retrofit energy studies of a recreation center.** Haberl, J.S.; Claridge, D. (Environmental and Architectural Engineering, Univ. of Colorado, Boulder, CO). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1421-1433(1985). (CONF-850606—).

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Retrofit energy options for the Student Recreation Center at the University of Colorado have been evaluated using the DOE-2.1b simulation program. This building has two major systems that are not included in the program - an ice rink and a swimming pool. The approach used to model these systems and the use of the program for other applications not included in the program, such as duty cycling and night cycling of fans for freeze protection, are emphasized. Measures that help streamline the usage of the program on a minicomputer are also discussed.

46066 **Thermal comfort of building occupants: A preliminary impact assessment of passive strategies.** Coutier, J.P.; Kammerud, R.C.; Place, J.W. (Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 62-74(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

The importance of comfort problems in passive buildings is underlined by the growing feeling that total energy analysis for

buildings should take into account occupants' response to their environment. Occupant comfort issues, i.e., visual comfort, thermal comfort, and air quality, are discussed in general terms. Particular attention is given to thermal comfort, which is shown to have a significant impact on the occupants' response to thermal nonuniformities within buildings, particularly those using passive strategies. A brief review of the available results on comfort is given and the program modeling the human thermal response to the environment is described. This state-of-the-art model is added to the simulation program BLAST and preliminary results of comfort levels are outlined. The example of daylit office buildings is taken to show the interaction between thermal comfort and building energy analysis.

46067 Commercial building energy performance analysis using multiple regression. Sullivan, R.; Johnson, R.; Nozari, S.; Selkowitz. (Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2A, 337-353(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Regression analysis defines algebraic expressions that can be used to study the effects of various configurational parameters on building energy performance. The DOE-2.1B energy-analysis simulation program was used in conjunction with prototypical building modules to generate a large data base for five geographic locations. Configurational variables parameterized included orientation, wall and roof conductance, glazing properties of windows and skylights (area, U-value, shading coefficient, visible transmittance, well depth), and installed lighting power. Incremental effects due to external shading (overhangs) and daylighting were also examined. A constant volume variable temperature secondary HVAC system was attached to each zone in the model, and the individual zone coil loads were used as a basis for showing the versatility of the regression techniques. The modular concept permits generalization of the results to buildings of arbitrary floor/glazing areas, and the resulting regression expression conveniently categorizes those components of importance in building energy use.

46068 User-effect validation tests of the DOE-2 building energy analysis computer program. Diamond, S.C.; Cappiello, C.C.; Hunn, B.D. (Delta H Engineering, Ltd., Santa Fe, NM). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 712-724(1985).

In an earlier ASHRAE paper (Diamond and Hunn 1981), monthly and annual electric and fuel energy use predicted by the DOE-2 building energy analysis computer program was compared with measured energy use for five commercial buildings in a variety of climates. In each case, DOE-2 was run by an experienced analyst who was familiar with DOE-2 and the building analyzed. As an extension of this study, a comprehensive experiment was conducted by the Los Alamos National Laboratory to test the effect that the user had on the predicted results. The objective was to obtain a quantified characterization of the effects of the user under typical design conditions where detailed input data are not available initially but are improved or refined as the design process progresses. The results indicate how the judgement of different experienced users, and/or their interpretation of the input data, affect the dispersion (scatter) of energy use calculations made with DOE-2. In this experiment a round-robin of simulations of four commercial buildings was conducted; six contractors, each an experienced user of the program, ran DOE-2 for each of the buildings. Three levels of increasingly refined input data were used by each of the contractors. Results are presented, in terms of root-mean-square (rms) deviations from the predicted mean monthly and annual energy use for the cases of (1) uncontrolled input, (2) refined input, and (3) input constrained by the Standard Evaluation Technique defined for the Building Energy Performance Standards proposed by DOE.

46069 The high cost-effectiveness of cool storage in new commercial buildings. Rosenfeld, A.; delaMoriniere, O. (Univ. of California, Lawrence Berkeley Lab., Berkeley, CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 818-834(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

In new commercial buildings with demand meters, thermal storage is already cost-effective. The cheapest strategy, partial storage, displaces two-thirds of cooling demand and can displace 3 GW each year in new U.S. buildings. The more expensive strategy of full-demand avoidance can shift another 2 GW. Partial storage uses a chiller, sized to run continuously. On a summer night, the excess chiller capacity goes to storing coolth, then the next afternoon this coolth is used to supplement the chiller. (This strategy requires the samllest capacity chiller and the smallest volume storage, i.e., the least first cost.) Demand-limited storage minimizes cost of operation by installing a somewhat larger chiller, sized to be able to turn off when power is most expensive. Both chiller and storage must be about 40% larger than what is required for partial storage. Many builders will go only as far as partial storage, which has a payback of less than three years. But from the point of view of society and the utilities, full-peak avoidance will in the long run save money and power plants. We discuss the attractiveness of both strategies for the customer and for the utilities.

46070 Evaluating the measured results of demand-control strategies in new and retrofitted commercial buildings. Meal, M.A.; Piette, M.A.; Gardiner, B. (Buildings Energy Data Group, Lawrence Berkeley Labs., CA). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 961-974(1985). (CONF-850606—). Contract AC03-76SF00098.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

There has been little evidence that demand-control techniques have succeeded in reducing power demand, or that their implementation has been cost-effective. To fill this gap, the measured results of demand-control in new and retrofitted commercial buildings are being compiled. Various demand-control strategies and their impact on power and energy consumption, and a methodology for analyzing the measured performance of these demand-control strategies are described. Four performance indicators are developed and applied to 17 buildings that have implemented demand control. The limitations to using whole building data to evaluate peak power performance in the commercial sector are discussed.

46071 Predicted energy conservation in existing small commercial buildings. Mixon, W.R. (Oak Ridge National Lab., Oak Ridge, TN). *ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) Transactions;* **91**: No. 2B, 1510-1515(1985). (CONF-850606—). Contract AC05-84OR21400.

From American Society of Heating, Refrigerating and Air-Conditioning Engineers' semiannual meeting; Honolulu, HI, USA (23 Jun 1985).

Research has recently been completed to characterize typical small commercial buildings existing in the United States and to assess the potential of retrofit measures to reduce the energy use and peak electric demand. The focus has been on commercial buildings that will be eligible under the Commercial and Apartment Conservation Service (CACS) Program mandated by Congress, i.e., with annual energy consumption less than 48 thousand kWh of electricity and 12 thousand therms of any other fuel. Estimates of retrofit energy savings were based on representative physical and energy-use characteristics selected from information collected on 291 small commercial buildings in nine cities. Energy-use profiles varied significantly with building type and location, but total annual energy savings of 26 to 49% were predicted from use of five common retrofit measures in modern strip-type and older two-story building models. Peak electric demand ranged from 15 to 50 KW for these models, with predicted retrofit savings of 4 to 29 KW.

46072 The control of daylight-linked lighting systems. Rubinstein, F.; Ward, G. (Lighting Systems Research, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1249-1252 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—). Contract AC03-76SF00098.

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

This paper describes the components of a daylight-linked lighting system and presents three simple control algorithms that can be incorporated into a control system to achieve the design objective of constant task illuminance.

46073 Defining daylighting from windows in terms of candlepower distribution curves. Spitzglas, M. (Windows and Daylighting Group, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1253-1258 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—). Contract AC03-76SF00098.

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

This work describes a method for evaluating quantitatively the daylight admittance of windows under any outdoor conditions in terms that make it possible to calculate interior light distribution. The visible daylight flux introduced through a window (or other daylight-admitting aperture) can be considered, from the point of view of the internal space, as being emitted from a point source or from a finite-area uniform source. The photometric properties of those light sources are designed in terms of the well-known candlepower distribution curves. The ways in which this approach can can be applied for different window designs are demonstrated. This approach to the photometric properties of window systems allows one to translate typical daylighting calculation problems into a format in which they can be resolved using tradition electric lighting calculations or computer codes. Even "daylighted-oriented" computer codes are limited as to the geometric complexity of the windows they can model-this method eliminates such limitations. It will also contribute to a better understanding and visualization of the photometric properties of various windows and other daylight-admitting elements. This approach, therefore, may also serve as an educational tool.

46074 Development of novel lamps for study of enhanced production of resonance radiation by low-density mercury discharges. Wang, Z.X.; Hollister, P.P.; Berman, S.M. (Lighting Systems Research, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1259-1262 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—). Contract AC03-76SF00098.

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

A novel mercury-argon discharge tube is described. It incorporates two identical condensation pump "cold spots" that are employed to determine both the mercury sorption rate and the coefficient of free diffusion for mercury in argon. Equilibration periods for this systems are found to depend in part on the temperature difference between the two cold-spots surfaces, and on the separation of these surfaces. Sorption of mercury at the discharge tube's surface, and the subsequent cleanup of the mercury charge, is determined by the time rate of change in the equilibration period. Data accumulated during theses test are incorporated into the design scheme of discharge tubes intended for Zeeman-effect and isotope blending studies described elsewhere.

46075 Electromagnetic interference from fluorescent lighting operated with solid-state ballasts in various sites. Harms, M.G.A.; Leung, L.P.; Verderber, R.R. (Lighting Systems Research, Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 1267-1274 of Conference record of the Industry Applications Society IEEE-IAS-1984 annual meeting. Piscataway, NJ; IEEE Service Center (1984). (CONF-8409108—). Contract AC03-76SF00098.

From IEEE-IAS meeting; Chicago, IL, USA (30 Sep 1984).

Solid-state ballasts with 20-30 kHz fundamental frequencies were used to operate fluorescent lamps in office, screen room, and open-field sites. The test equipment and layout are described and the radiated and conducted electromagnetic interference (EMI) data are given for six commercially available ballasts from different manufacturers. EMI data from each location are presented that indicate the suitability of using an office site for future EMI measurements. Broadband EMI data are compared with data from a spectrum analyzer, which justifies the use of an RMS voltmeter in these measurements. A reduction in radiated EMI of 36 dB is achieved by replacing a strip fixture with an EMI-hardened fixture that has a wire grid embedded in its lens. Results of increasing lamp/antenna distance are given; we verify that, for distances greater than 1 meter, the radiated EMI amplitude drops off as a function of $1/d^3$.

3202 Transportation

46076 (CONF-8606112—3) Transportation energy demand from 1980 to 2010: structure and results of the Transportation Energy and Emissions Modeling System. Vyas, A.; Millar, M.; Patterson, P. (Argonne National Lab., IL (USA); USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Transportation Systems). 1986. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014495.

From IASTED modelling and simulation conference; Vancouver, Canada (4 Jun 1986).

As part of ongoing work for the US Department of Energy (DOE), Argonne National Laboratory's Center for Transportation Research develops detailed forecasts of US transportation energy demand, by mode and fuel type. These forecasts are generated by a model system of linked component modules of local personal travel demand, intercity travel demand, and goods movement. The local personal travel component uses an iterative proportional fitting technique to project household characteristics by several demographic variables and an incremental logit model to predict changes in household vehicle holdings. The intercity travel module is a network-based, direct-demand formulation based on utility-maximizing principles. The freight module is driven by econometric forecasts of sectoral output. Mode shares are determined by sampling a series of probability-density functions of shipment attributes and shipper preferences. Major inputs include exogenous economic, demographic, and price assumptions; outputs include long-range modal and submodal forecasts of transportation stock, activity, and energy demand. This paper documents the methodology and presents selected results from the latest run of the model system.

46077 (DOE/ER/30063—H2) Advanced propulsion systems and alternative fuels for non-highway transportation. Annex and compendium of research and development. [Final report. Volume 3]. (Mueller Associates, Inc., Baltimore, MD (USA)). Jan 1986. Contract AC01-84ER30063. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86013158.

Based upon earlier prioritization and assessment analyses, a selection of R and D needs were identified for non-highway transportation. The Department of Energy's Office of Program Analysis (DOE-OPA) in recognizing the likelihood of only limited Federal Government monetary support of Non-Highway R and D, requested that these R and D needs be further prioritized to a limited number (four to six) of recommendations. This paper presents the logic and rationale for arriving at this much smaller set of R and D priorities and re-summarizes the specific R and D needs and their potential benefits and/or utility.

46078 (PB—86-205192/XAB) Energy analysis and alternative fuels and vehicles. Brunso, J.M.; Hartgen, D.T.; Singh, M.K.; Teotia, A.P.S.; Johnson, L.R. (National Research Council, Washington, DC (USA). Transportation Research Board). 1985. 109p. (TRB/TRR—1049). NTIS, PC A06/MF A01.

The 12 papers in the report deal with the following areas: consumer trade-offs between mobility maintenance and gasoline savings; environmental concerns of natural gas vehicles: do we know enough; structural ceramics in transportation: fuel implications and economic effects; commercialization of major efficiency-enhancing vehicular engine innovations: past, present and future micro-and macroeconomic considerations; a quick assessment of

local area impacts resulting from national energy shortages; define relationships between urban form and travel energy; an analysis of trends in automotive fuel economy from 1978 - 1984; long-term outlook for transportation energy demand; the potential market for electric vehicles: results from a national survey of commercial fleet operators; alternative fuels for buses: current assessment and future perspectives; user costs and fuel consumption at drive-through facilities; utility industry progress toward implementing electric vehicle introduction.

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REFER ALSO TO CITATION(S) 45685, 46158

46079 (CONF-8510259—, pp 3-5) **Temperature by time of flight of sound waves.** Parthasarathy, S. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

Transit times of sound waves over a path through a medium, e.g., hot gases, can be measured with a simple transducer. Average times over the whole path are easier to measure than local values over a small region and may be useful enough to be directly applicable to the determination of the average temperature across a boiler or lime kiln. Local values can be determined by using the information on transit times across two laser beams which sense sound waves. A potential problem with this approach is the need to know the chemical composition of the gas, which influences the speed of sound. A possible solution to this problem is to use a tube filled with nitrogen and pulse the sound waves through the known gas.

46080 (CONF-8510259—, pp 5-7) **Polymeric hygrometer sensor.** Parthasarathy, S. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The objective of this project is to study the feasibility of using a polymeric hygrometer for determining the relative humidity in the pulp and paper industry. The material being investigated for use in the sensor is nafion, which is a solid fluorocarbon polymer electrolyte that has a conductivity which varies as a function of relative humidity and temperature. A prototype sensor system has been fabricated and preliminary laboratory and mill tests are being conducted. During the initial 20 hours of testing the hygrometer reading agreed with measurements performed by using a wet and dry bulb thermometer. The results of the tests are discussed.

46081 (CONF-8510259—, pp 7-8) **Steam flow meter (JPL).** Parthasarathy, S. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

Aeroacoustic sources can produce sound waves in a steam pipe by using the energy of flow itself. There are no limitations of temperature and pressure and there are no moving parts. In this method, (c + u) and (c - u) are directly measured by the time-of-flight of sound waves with and against the flow. The temperature which depends on c and u are directly measured. Experiments on this concept using several types of sources are described.

46082 (CONF-8510259—, pp 9-12) **In-situ combustion control.** Charagundla, R. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The spectroscopic in-situ combustion temperature measurement technique is based on the measure of emission intensities from the combustion zone. Field trips to two paper companies produced information on the emission spectra from recovery boilers. Information on the emission spectra in the wavelength range of 300 to 800 nm was obtained. The studies indicated that line emission intensities at two different wavelengths (404.4 nm and 766.5 nm) can be used to estimate gas temperatures by the line intensity ratio. The temperatures estimated using this method were found to compare favorably with calculated adiabatic flame temperatures.

46083 (CONF-8510259—, pp 12-15) **Consistency sensor.** Gaigalas, A. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The development of a new technique for the on-line measurement of pulp consistency which has improved performance characteristics over currently available devices is discussed. The approach uses an RF technique in which the pipeline carrying the pulp flow is used as a waveguide. Radio frequency energy is introduced into the waveguide at two points such that EM waves traveling in opposite directions pass through the field strength detector portion of the sensor. Interference between the two waves causes modulation of the power level in the waveguide. This modulation is detected by a diode array flush mounted to the waveguides inner wall. Analysis of the power modulation data results in a measurement of the wavelength and attenuation of the EM field in the waveguide. From these measurements, the dielectric properties of the material feeling the waveguide can be determined. Since the dielectric constants of water and cellulose differ by a factor of about 20, the volume fraction of cellulose may be determined.

46084 (CONF-8510259—, pp 15-17) **Steam flow meter (NBS) work sheet - preliminary results.** Emerson, D. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

An evaluation of the NBS steam flow meter is presented. NBS had demonstrated the technical feasibility of a non-intrusive meter that provides a continuous measurement of steam temperature, velocity, and mass flow. However, the relatively large meter length requirements and materials/engineering problems associated with the sound source presented potential problems that might significantly detract from widespread industry acceptance. A summary of the findings of a potential user acceptability survey are presented.

46085 (CONF-8510259—, pp 17-19) **Process sensor availability and needs - draft report summary.** Emerson, D. 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

At a previous Sensor Working Group meeting it was recommended that DOE consider conducting a survey study of the current status of sensors used by the pulp and paper industry. In response to the recommendations, DOE authorized a two-part effort to determine equipment availability and acceptability. The results of this study on process sensor and availability needs are presented.

46086 (CONF-8510259—, pp C.2-C.16) **Steam flow meter.** Parthasarathy, S.P.; Kwack, E.Y. (California Institute of Technology, Pasadena). 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The development of a steam flow meter is summarized. The meter uses an aeroacoustic source located at the center of a free jet issuing from a nozzle. The jet flow speed is 150 m/s. Data are presented on the sound pressure levels in the pipe and in the jet.

46087 (CONF-8510259—, pp C.18-C.23) **DOE-JPL hygrometer.** Lawson, D.D.; Parthasarathy, S.P. (California Institute of Technology, Pasadena). 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The objective of this project is to investigate the feasibility of using a polymeric hygrometer for determining relative humidity in the pulp and paper industry. The material being investigated for use in the sensor if nafion, which is a solid fluorocarbon polymer electrolyte that has a conductivity which varies as a function of relative humidity and temperature. A prototype sensor system has been fabricated and preliminary laboratory tests conducted.

46088 (CONF-8510259—, pp D.5-D.56) **Spectroscopic temperature measurement technique for recovery boilers.** Charagundla, S.R.; Semerjian, H.G. (National Bureau of Standards, Gaithersburg, MD). 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The objective of this study was to develop an in-situ spectroscopic temperature measurement technique for combustion control in black liquor fired recovery boilers. The approach was to identify spectra and establish relationships between stoichiometry and line intensity ratios and to develop and fabricate a portable fiber optic probe/detector system for temperature measurement in black liquor recovery boilers. Conclusions and recommendations for future work are presented.

46089 (CONF-8510259—, pp E.2-E.17) **New approach to the measurement of paper pulp consistency.** Gaigalas, A.K. (National Bureau of Standards, Gaithersburg, MD). 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The effective dielectric constant of a paper pulp slurry flowing in a pipe with diameter equal to 6.25 inches was determined by measuring the wavelength, frequency, and attenuation of radio waves propagating inside the pipe. The solids percent was obtained from the effective dielectric constant by using a mixing model. Good agreement was obtained with values of percent solids (cellulose) obtained from grab sample measurements.

46090 (CONF-8510259—, pp F.1-F.11) **Research on the behavior of non-process elements in alkaline pulp mills.** Frederick, W.J. Jr. (Oregon State Univ., Corvallis). 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

The behavior of non-process elements in alkaline pulp mills is described. Examples of such inorganic elements in chemical pulping cycles not associated with active pulping chemicals include Al, Ca, Cl, Fe, K, Mg, Mn, and Si. The impact of non-process elements on capital and energy requirements in mill design and operation is discussed.

46091 (CONF-8510259—, pp G.2-G.67) **Presentation summary of The National Bureau of Standards steam flowmeter worksheet.** 31 Oct 1985. NTIS, PC A10/MF A01. File Number DE86005722.

From DOE/industry advanced research and development sensor working group meeting; Chicago, IL, USA (31 Oct 1985).

A summary of the work at NBS on the development of a steam flowmeter is presented. The objectives of the work were to: (1) obtain information on the potential user acceptance of a NBS-developed non-intrusive steam flowmeter, (2) evaluate the information obtained, (3) determine which criteria are associated with high and low potential user acceptance, and (4) to summarize and report the findings for use in an overall evaluation of the steam flowmeter development effort.

46092 (DOE/ID/12502—1) **Development of synergistic waste treatment into applied technology.** Tabor, W.E.; Dempsey, D.G.; Taylor, S.J.; Ervin, A. (Enwright Research Corp., Greenville, SC (USA)). Jul 1986. Contract AC07-84ID12502. 218p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE86014115.

The contract terms were carried out as specified by DOE with the authors investigating known or practical examples of synergistic and antagonistic effects resulting of mixing of wastewater streams. Databases were compiled on the waste stream characteristics and waste treatment practices of 12 subcategories of the chemical and allied products industry. Both a qualitative and quantitative computer model were developed to select appropriate treatment procedures and to predict the potential interactive effects upon the mixing of two streams; afterward, the data were supplemented by calculation of energy use and calculation of potential savings which could occur from beneficial interactions between the streams. Results of about seven simulation trials indicate potential energy conservations if the concepts are developed and used. This project has yielded great opportunity for deployment of a new concept in wastewater treatment practices.

46093 (DOE/ID/12539—T1) **Evaluation of ceramic construction joints for application to high recuperative heat exchangers. Final report.** Dennis, A.J. (United Technologies Research Center, East Hartford, CT (USA)). Jan 1986. Contract AC07-84ID12539. 31p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014122.

Certain ceramic composite materials are potentially well suited to being used as joints and seals. These materials are attractive because of their compliance, toughness and thermal expansion properties. Various joint designs, which take advantage of the differential thermal expansion between the ceramic heat exchanger tube and the ceramic composite sleeve, were analyzed. The differential thermal growth provided a sealed joint. The primary design parameters of cold assembly clearance (gap), joint engagement length (lap) and thickness distribution (taper) of the sleeve were selected to place the maximum stresses in the ceramic composite sleeve while maintaining the ceramic tube in an acceptably low compressive stress state. Standard finite element analyses were conducted. The initial cold clearance (gap) was determined to be the most effective design parameter in reducing the strsses in the joint; that is, the larger the gap the lower the maximum joint stresses at operating conditions.

46094 **Energy and the future of electrolytic metal recovery.** Cook, G.M. (Argonne National Lab., Argonne, IL 60439). pp 1-12 of Energy reduction techniques in metal electrochemical processes. Bautista, R.G.; Wesely, R.J. Warrendale, PA; The Metallurgical Society, Inc. (1985). (CONF-850211—).

From 114. AIME annual meeting (includes Society of Mining Engineers); New York, NY, USA (24 Feb 1985).

Past studies specifically directed at reducing the quantity of energy used in the electrolytic recovery of metals have been successful in many ways. Future efforts, however, need to be directed toward reducing the energy consumption of the overall industrial processes that incorporate the electrolytic recovery of metal. In this regard it is important to consider the relative quantities of electrical and thermal energy required by the complete processes. The efficiency of converting fuel into usable thermal energy is on the order of 80% whereas the efficiency on conversion into electricity is only about 32%. Furthermore, thermal energy requirements are readily minimized by using adequate insulation and recuperatively designed equipment. Therefore the greatest opportunity for saving energy lies in reducing the electrical portion of the energy requirement. This paper reviews some of the previous approaches to reducing energy use in the electrolytic production of primary metals, identifies typical business and technical problems that have prevented the wider acceptance of these energy saving alternatives and speculates on the future form of the technology.

46095 **The Department of Energy's Advanced Heat Exchangers Program.** Hayes, A.J.; Richlen, S.L. (U.S. Dept. of Energy, Washington, DC). pp 21-27 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

The Advanced Heat Exchanger Program is an initiative on the part of the United States Department of Energy - Office of Industrial Programs to foster the development and use of advanced waste heat recovery technology in U.S. industry. Initial efforts in 1976 resulted in the commercialization of three improved heat exchangers. The two HTBDR projects initiated in 1981 have developed large ceramic tubular high temperature heat exchangers scheduled to be field tested in 1985. The two FBWHRS projects, also initiated in 1981, have developed advanced fluidized bed waste heat recovery units. One is currently being field tested, the other is scheduled for field test in 1986. Beginning in 1983 the direction of the program was changed. The emphasis on field site demonstrations was lessened while an increased emphasis was placed on research of basic technologies identified as needed for development

of advanced heat exchangers. Specific efforts such as development of high temperature seals, exposure testing of ceramic materials, new forming techniques for ceramics, assessment of composites as a potential heat exchanger material, assessment of flaws in ceramic components, development of advanced NDE techniques, study of enhancement and fouling reduction, and design of advanced configurations have been initiated to provide a broad base of support to the U.S. industry.

46096 **Design verification of the DOE/B & W HTBDR control system using interactive simulation.** Godbole, S.S.; Gilbert, M.L.; Snyder, J.E. (Babcock & Wilcox, Lynchburg, VA). pp 45-49 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Babcock & Wilcox (B & W) is participating with the U.S. Department of Energy to design, construct, install, and evaluate a high temperature burner-duct-recuperator (HTBDR) system. The modulating control system specification was developed using an interactive digital simulation of the HTBDR system. The burner startup and interlock logic design was also debugged using the simulation. It is expected that this approach will be cost effective in terms of increased probability that the control, sequencing, and interlock logic systems will permit satisfactory pit operation with a minimum of field modifications during initial startup. The simulation was developed on a Modcomp Classic minicomputer connected to an operator interface panel featuring burner startup panel mockup, hand/auto and set point stations, panel indicators for important process variables, and the ability to introduce equipment malfunctions. The simulation also allows store/restore of desired process conditions (e.g., cold lightup, pit at 1600°F), modification of parameters (e.g., controller tuning), and trend of selected variables. With these features the user can simulate the operation of a pit at any speed between real-time and 180 times faster than real-time. The simulation was subsequently implemented on an IBM PC.

46097 **Ceramic tubular heat exchangers: A summary of seven years of operating experience.** Woodward, R.M.; LaHaye, P.G. (Hague International, South Portland, ME). pp 133-142 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Hague International ceramic tubular heat exchangers have been in commercial operation since 1978. These heat exchangers are designed for applications involving high temperatures (1800°F - 2800°F; 980°C - 1540°C) with relatively large thermal inputs (4MMBtu/hr (1170 KW) and up). To date (June, 1985) such heat exchangers have accumulated more than 500,000 hours of operating experience on steel heating and aluminum melting furnaces. The first installation on a steel heating furnace took place in June, 1978. A Department of Energy survey of 11 installations found overall fuel savings due to Hague equipment to average 48%, with reported savings of up to 60%. CerHx heat exchangers have been installed on aluminum melting furnaces since July, 1981. Heat recuperation has not been widely used in the aluminum industry, as chlorine and chloride fluxing agents severely attack metallic heat exchangers, necessitating complex and costly protective devices. The CerHx heat exchanger can be directly exposed to furnace exhaust gases during fluxing, requiring no bypass system. Aluminum industry representatives often consider such information to be proprietary, but an overall average fuel consumption reduction of 28% - 35% is a conservative and realistic expectation.

46098 **A survey of gas-side fouling measuring devices.** Marner, W.J.; Henslee, S.P. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA). pp 209-226 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

A survey of measuring devices or probes used to investigate gas-side fouling has been carried out. Five different types of measuring devices are identified and discussed including: heat flux meters, mass accumulation probes, optical devices, deposition probes, and acid condensation probes. The capabilities and operating experience of 32 different probes are described and summarized in tabular form. The results of this study show that considerable work has been done in the development of gas-side fouling probes. However, it is clear that the design, construction, and testing of a durable, versatile probe -- capable of monitoring on-line fouling resistances -- remains a formidable task.

46099 **Industrial fouling data base development.** Fassbender, L.L. (Pacific Northwest Lab., Richland, WA). pp 227-238 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—). Contract AC06-76RL01830.

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Recently the Pacific Northwest Laboratory (PNL) developed a computerized fouling data base for the Department of Energy (DOE). To ensure the adequate definition and organization of the data base, they assembled a panel of consultants who are leading experts in the fundamental and applied aspects of fouling and corrosion of heat-transfer surfaces. This panel of experts met in a workshop session with PNL scientists and engineers to define the most appropriate contents of the data base and its organization to meet existing and potential future needs. They developed two major flat files to compile the data: (1) a comprehensive technical data file of quantitative and qualitative data. (2) a bibliography/abstract file of information about the documents and authors, keywords and abstracts summarizing the documents. The two flat files are loaded into three separate data bases: (a) The technical data base containing the technical data file expressed in English units. (b) The technical data base containing the same technical data file, but expressed in SI units. (c) The bibliograpy/abstract data base containing the bibliography and abstract file. PNL reviewed about 200 references, mostly on gas-side fouling, and relevant data was entered into the data base.

46100 **Costs of heat exchanger fouling in the U.S. industrial sector.** Smith, S.A.; Dirks, J.A. (Battelle Northwest Labs., Richland, WA). pp 339-344 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Heat exchangers are used in many heat source, heat sink and process applications throughout the U.S. industrial sector. In 1984 heat exchanger sales totaled $1.3 billion (in 1984 dollars), and sales are expected to grow at 6% per year through 1985. The presence of fouling in heat exchangers represents an additional cost to the industrial sector in terms of additional capital, energy, and labor. Several estimates are available on the costs of fouling to specific industries; however, no real attempt has been made to estimate these costs for the entire industrial sector. The objective of this paper is to provide an order-of-magnitude estimate of the costs of fouling to the U.S. industrial sector. Specifically, costs are estimated for: oversizing and specialty materials; increased energy costs; downtime; lost production.

46101 **Laser processing of materials.** Polk, D.H.; Banas, C.M.; Frye, R.W.; Gagosz, R.A. (United Technologies Research Center, East Hartford, CT). pp 357-364 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Development of gas and solid-state lasers suitable for industrial use has led to increasing activity in process development and production applications. Laser systems are easily controlled, readily automated, and can provide higher power densities than any other convenient energy source. Readily attainable power intensities as great as 10^9 W/cm^2 (equivalent to that from a thermal source at 65,000 K) provide the capability for vaporizing any known materi-

al. At the higher intensities, drilling and cutting of materials with minimum hole diameters/kerf widths of the order of a few wavelengths in extent are possible. Lower intensities, of the order of 10^6 W/cm^2, are used for keyhole welding and yield narrow, high-depth-to-width-ratio welds with minimal heat-affected zones. At still lower intensities, lasers are effectively used for surface treating processes which include transformation hardening, hardfacing, and surface alloying. A brief review of the characteristics of lasers pertinent to materials processing, identification of unique processing capabilities, and specific examples of drilling and welding relevant to heat exchanger manufacture is presented. The latter includes tests on silicon carbide and silicon nitride ceramics which are being considered for high temperature heat exchanger applications. The significance of demonstrated laser materials processing capabilities relative to potential application to high-temperature heat exchanger fabrication is discussed.

46102 **Remote and in-situ analysis.** Hirschfeld, T. (Chemistry & Materials Science Dept., Lawrence Livermore National Lab., Livermore, CA 94550). pp 305-318 of Proceedings of the ISA/85 international conference and exhibit. Research Triangle Park,NC; Instrument Society of America (1985). (CONF-851045—).

From Instrument Society of America international conference and exhibit; Philadelphia, PA, USA (21 Oct 1985).

As analysis continues to move out from the laboratory into the factory, the high cost of multiple on-line instruments and the conservative technology needed for unattended operation in a hostile environment have become serious limitations. Remote measurements, using selective optical sensors ("optrodes") at the end of a fiber optic network operated by a single central instrument, are a solution to these problems. They allow the instrument to stay in the benign environment and high support level of the laboratory, while the low cost sensors can be multiplied to provide extensive and cost effective monitoring. A further trend, as yet in its infancy, is the movement of analytical and diagnostic capability out from the production line into the product. A number of low cost disposable sensors for this application are described.

46103 **Advanced high performance ceramic heat exchanger designs for industrial heat recovery applications.** Kleiner, R.N.; Coubrough, L.E. (Coors Porcelain Co., Golden, CO). pp 51-56 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Metal compact heat exchangers are available in many high performance designs but in general, they are not cost-effective above 1600°F operating temperature. Ceramic heat exchangers are cost effective at these high temperatures but have not been fabricated in high performance designs for industrial applications. To meet the need for a cost-effective, high temperature recuperator in sizes less than 1MM Btu/hr, several advanced high performance design recuperators have been made through advances in the state-of-the-art in ceramic fabrication technology. These new designs will extend the product application areas of ceramic heat exchangers and yield benefits to the end user through more efficient energy utilization.

46104 **Fluid bed waste heat recovery performance in a hostile environment.** Hoffman, L.C.; Williams, H.W. (Aerojet Energy Conversion Co., Sacramento, CA). pp 87-93 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Operating experience with fluid bed waste heat recovery units under internally hostile environments are compiled for the first time. Six waste heat boiler installations on industrial furnaces, kilns, and engine exhaust streams are discussed. Hostile environments include high gas temperatures, fouling particulates, corrosive streams and thermal cycling. The first industrial fluid bed for heat recovery in the free world, and the first in the U.S., are described with operating experience discussed. Shallow fluid bed heat recovery was established in the early 1970's to inherently provide tolerance to hostile waste heat environments. It also holds promise for a more compact unit. Experience since then has shown the objectives to be met in a number of cases. Experiences in the metals, cement, petroleum and brick industries encompass combinations of high temperature, fouling, corrosion and thermal cycling conditions. These are described. This summary of experiences and conditions provides general background material for capability and limitations in Fluid Bed Waste Heat Recovery Boilers.

46105 **Laboratory test results of the Fluidized-Bed Waste-Heat Recovery system.** Patch, K.D.; Cole, W.E.; Patton, J.B. (Thermo Electron Corp., Waltham, MA). pp 95-99 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

The Fluidized-Bed Waste-Heat Recovery (FBWHR) system is being developed to preheat combustion air for industrial furnaces. In many of these furnaces the flue gases are dirty and corrosive, causing severe fouling and materials problems. The FBWHR system solved these problems by using a durable, direct contact heat exchanger, eliminating conventional gas-to-air heat exchanger surfaces. The FBWHR system employs a heat-transfer particulate media, which is heated as it falls through upward following flue gases in a raining-bed heat exchanger. These heated particles are passed across a fluidized-bed heat exchanger heating ambient temperature combustion air, and are then returned in their cooled state to the raining bed for reheating. Features of this widely applicable system are: a capability of over 649°C (12000°F) combustion air preheat; the raining bed can be constructed from a wide selection of corrosion-resistant materials; low flue gas pressure loss (allowing natural draft); and freedom from fouling problems. A subscale FBWHR system sized for a 1.46-MW (5-MBtu/hr) furnace was fabricated and tested over a wide range of temperatures and flow conditions. Subscale testing resulted in 649°C (12°F) preheated combustion air from 10°C (200°F) exhaust gases, less than 50 Pa (0.2 in. wc) flue gas pressure loss in the raining bed, 2.74 kPa (11 in. wc) airside pressure loss in the fluidized bed, and a low elutriation rate of media from the system. Pilot plant testing of the FBWHR system surpassed program goals. Advancing the technology through the commercialization stage is now underway. The initial steps of this FBWHR system commercialization are the design, construction and testing of a full-scale demonstration unit on an aluminum smelting furnace.

46106 **Vortex Flow Direct Contact Heat Exchanger conceptual design and performance.** Rodgers, R.J. (United Technologies Research Center, E. Hartford, CT). pp 101-107 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

The Vortex Flow Direct Contact Heat Exchanger represents a new approach for high temperature (2500°F) heat recovery from industrial waste heat flue gas streams. In the vortex flow direct contact heat exchanger, the material wall of conventional metal or high temperature ceramic heat exchangers is replaced by a vortex induced fluid dynamic gas boundary which separates the tangentially rotating hot and cold gas flows between which heat exchange is desired. Small particles entrained with the central hot gas flow are centrifuged out through the surrounding cold gas and transfer heat between the flows by convective heat transfer as they proceed along their spiral trajectories through the vortex volume. A fluid dynamic flow and heat transfer analysis with the results integrated into a vortex flow heat exchanger conceptual design study is presented. The results of fluid dynamic modeling of the heat exchanger to define vortex injection flow conditions, gas velocity distribution, and pressure distribution are included. The influence of particle size distribution on the particulate mass flow and heat transfer rate is shown. Principal system component requirements are outlined for high temperature industrial waste heat recovery from a gaseous flow stream.

46107 **Industrial markets for waste heat recovery.** Moore, N.L. (Battelle Northwest Labs., Richland, WA). pp 325-329 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

The benefits of waste heat recovery are generally well known. However, details concerning specific equipment types and the many design and cost considerations involved in applying waste heat recovery equipment are less well known. Over 400 companies are presently manufacturing waste heat recovery equipment. They produce a variety of equipment including, but not limited to: heat recovery boilers, gas-to-gas exchangers, shell-and-tube exchangers, spiral heat exchangers, and plate exchangers. These manufacturers range in size from multi-million dollar corporations to literally one-man shops. The tools of cost engineering analysis are needed to ensure that technically feasible engineering projects are also economically attractive business ventures. Rising fuel prices and threat of supply curtailments accelerated both the implementation for new equipment and interest in developing more advanced equipment from 1973 through 1980 and economic assumptions during this time included escalation rates for fuels. Since 1980, waste heat recovery equipment has had to be sold on its economic merits based on static (or even de-escalating) rates for energy. With most American business demanding a 2-year simple payback, the waste heat recovery equipment industry has had to place renewed emphasis on the economics of heat recovery.

46108 **Cost/performance analysis of high temperature waste heat recovery equipment.** Rebello, W.J.; Moonis, R.A.; Richlen, S.L. (PAR Enterprises Inc., Fairfax, VA). pp 331-337 of Industrial heat exchangers. Hayes, A.J.; Liang, W.W.; Richlen, S.L.; Tabb, E.S. Metals Park, OH; American Society of Metals (1985). (CONF-851106—).

From Industrial heat exchanger technology symposium; Pittsburgh, PA, USA (6 Nov 1985).

Over the past few years, government and industry sponsored research has led to the development of more effective recuperators that can be used in relatively clean, high temperature environments. Efforts are now underway to develop new and innovative heat exchangers that will withstand high temperature as well as handle contaminated furnace exhausts. These newly developed recuperators must be cost competitive and satisfy the performance requirements of industry if they are to be successfully commercialized. Because the cost of gas-to-gas high temperature heat recovery equipment varies greatly depending upon the application, it would be useful to compare both cost and performance parameters of several heat exchangers simultaneously and to generalize these parameters into a single cost versus performance factor for the various types of recuperators. This paper presents the methodology to compare the cost and performance of presently available commercial recuperators with those that are presently being developed. The factors resulting from the survey and analysis are presented in a graphical format by size and by furnace exhaust temperatures. These factors are useful in determining what new technologies should cost to be competitive and how the effective their improved performance or the use of substitute materials would be in reducing costs.

3206 Municipalities And Community Systems

46109 **(BNL—51999) District heating and cooling market potential and penetration methodology. Final report.** Metz, P.D.; Gleason, J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1986. Contract AC02-76CH00016. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014740.

This report describes the district heating and cooling (DHC) market potential and penetration methodology development tasks performed under Part I of the project "District Heating and Cooling Market Potential and Penetration Study" for the US DOE. Market potential and penetration methodologies were surveyed to identify those suitable for assessing the feasibility of DHC systems in the US, i.e., of translating the characteristics of each system to its market response. Each methodology was evaluated in terms of its level of detail, data requirements, costs, and other factors. A "preferred" methodology was developed, and a prognosis for implementing the preferred methodology was made.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 45755, 46116

46110 **(N—86-24933) Statistical prediction of dynamic distortion of inlet flow using minimum dynamic measurement. An application to the Melick statistical method and inlet flow dynamic distortion prediction without RMS measurements. Final Report.** Schweikhard, W.G.; Chen, Y.S. (Kansas Univ. Center for Research, Inc., Lawrence (USA)). Apr 1986. 216p. (NASA-CR—176764). NTIS, PC A10/MF A01.

The Melick method of inlet flow dynamic distortion prediction by statistical means is outlined. A hypothetic vortex model is used as the basis for the mathematical formulations. The main variables are identified by matching the theoretical total pressure rms ratio with the measured total pressure rms ratio. Data comparisons, using the HiMAT inlet test data set, indicate satisfactory prediction of the dynamic peak distortion for cases with boundary layer control device vortex generators. A method for the dynamic probe selection was developed. Validity of the probe selection criteria is demonstrated by comparing the reduced-probe predictions with the 40-probe predictions. It is indicated that the the number of dynamic probes can be reduced to as few as two and still retain good accuracy.

46111 **(N—86-24938) Dilution jet mixing program, phase 3. Final Report.** Srinivasan, R.; Coleman, E.; Myers, G.; White, C. (Garrett Turbine Engine Co., Phoenix, AZ (USA)). Sep 1985. 186p. (NASA-CR—174884; GARRETT—21-5418). NTIS, PC A09/MF A01.

The main objectives for the NASA Jet Mixing Phase 3 program were: extension of the data base on the mixing of single sided rows of jets in a confined cross flow to discrete slots, including streamlined, bluff, and angled injections; quantification of the effects of geometrical and flow parameters on penetration and mixing of multiple rows of jets into a confined flow; investigation of in-line, staggered, and dissimilar hole configurations; and development of empirical correlations for predicting temperature distributions for discrete slots and multiple rows of dilution holes.

46112 **(N—86-25003) Life prediction and constitutive models for engine hot section anisotropic materials program. Annual Status Report.** Swanson, G.A.; Linask, I.; Nissley, D.M.; Norris, P.P.; Meyer, T.G.; Walker, K.P. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). Feb 1986. 203p. (NASA-CR—174952; PWA—5968-19). NTIS, PC A09/MF A01.

This report presents the results of the first year of a program designed to develop life prediction and constitutive models for two coated single crystal alloys used in gas turbine airfoils. The two alloys are PWA 1480 and Alloy 185. The two oxidation resistant coatings are PWA 273, an aluminide coating, and PWA 286, an overlay NiCoCrAlY coating. To obtain constitutive and/or fatigue data, tests were conducted on coated and uncoated PWA 1480 specimens tensilely loaded in the 100, 110, 111, and 123 directions. A literature survey of constitutive models was completed for both single crystal alloys and metallic coating materials; candidate models were selected. One constitutive model under consideration for single crystal alloys applies Walker's micromechanical viscoplastic formulation to all slip systems participating in the single crystal deformation. The constitutive models for the overlay coating correlate the viscoplastic data well. For the aluminide coating, a unique test method is under development. LCF and TMF tests are underway. The two coatings caused a significant drop in fatigue life, and each produced a much different failure mechanism.

46113 **(N—86-25476) Tribolgy of selected ceramics at temperatures to 900 deg C.** Sliney, H.E.; Jacobson, T.P.; Deadmore, D.; Miyoshi, K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 23p. (NASA-TM—87267; E—2969; CONF-860152—6). NTIS, PC A02/MF A01.

From 10. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (19 Jan 1986).

Results of fundamental and focused research on the tribological properties of ceramics are discussed. The basic friction and wear characteristics are given for ceramics of interest for use in gas trubine, adiabatic diesel, and Stirling engine applications. The importance of metal oxides in ceramic/metal sliding combinations is illustrated. The formulation and tribological additives are described. Friction and wear date are given for carbide and oxide-based composite coatings for temperatures to at least 900 C.

3302 External Combustion Engines

46114 **Heat pipe Rankine engine.** Chuah, Y.K.; Kreith, F. (Solar Energy Research Institute, Golden, CO). pp 3.616-3.619 of Intersociety energy conversion engineering conference, 20th, Miami Beach, FL, August 18-23, 1985, Proceedings. Volumes 1, 2, & 3. Warrendale, PA; Society of Automotive Engineers, Inc. (1985). (CONF-850808—).

From 20. intersociety energy conversion engineering conference; Miami Beach, FL, USA (18 Aug 1985).

The heat pipe Rankine (HPR) engine is a new concept for small scale power generation that uses heat and mass transport features of a heat pipe. A heat pipe is a heat transfer device in which heat is transferred efficiently from the evaporator section to the condenser section. Mechanical work is produced by a turbine placed in the vapor flowing between the evaporator and the condenser sections. As an external combustion engine, the HPR engine can utilize energy sources at various temperature levels and be adapted to different applications. 7 references.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 45974

46115 **(DOE/CS/50101—T15) Program Management for the US Department of Energy Electric and Hybrid Vehicles Program. Fifty-first monthly progress report, October 1985.** (Aerospace Corp., Washington, DC (USA). Electric and Hybrid Vehicle Directorate). Oct 1985. Contract AC08-80CS50101. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86014038.

Public Law 94-413, as amended by Public Law 95-238, authorizes the Department of Energy (DOE) to sponsor research, development, testing, and evaluation efforts to accelerate the development of electric and hybrid vehicles. Since its inception in 1976, the DOE Electric and Hybrid Vehicle (EHV) Program has sponsored a wide range of activities aimed at improving batteries, components, subsystems, and complete vehicles. Those activities involve a similarly broad range of technologies, and a multidisciplinary team is required to manage and monitor the activities effectively. The objective of the EHV Program is to expeditiously maximize the national petroleum savings potential of EHVs while providing energy and petroleum flexibility for the nation. This goal will be achieved by accelerating the research and development (R and D) of those technologies that could provide vehicles conductive to significant market penetration.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 46115

3307 Emission Control

46116 **(AD-A—167629/5/XAB) Agglomerating self-cleaning air cleaner. Final report.** Treuhaft, M.B. (Southwest Research Inst., San Antonio, TX (USA). Dept. of Engine and Vehicle Research). Oct 1985. 133p. (SWRI—03-7442). NTIS, PC A07/MF A01.

This report describes an experimental program to evaluate an agglomerating self-cleaning air cleaner concept for application to diesel-powered tactical trucks and combat vehicles. Technical feasibility was evaluated through laboratory testing of candidate agglomerating media and through a design parameter component study of the agglomerator, inertial separator, and final filter integration and system operation. Several factors were used to evaluate media potential: namely, initial resistance as a function of airflow, dust loading, and pressure-drop recovery; the improvement in inertial separator efficiency (an indirect measure of agglomerate transport); overall operating efficiency; and consideration of the physical characteristics of the media with respect to their likely influence on design. Both surface loading and depth-type media were considered, and successful results were obtained with each. Overall, results clearly show that the agglomerating self-cleaning air cleaner concept can provide a significant improvement over standard systems with respect to service life. As a result, an air-cleaner system based on this concept would fill the void between larger self-cleaning air filter (SCAF) units and the smaller cylindrical units currently used on many tactical trucks and small combat vehicles. This will allow the smaller vehicles, which cannot readily accept extended-life units, to function satisfactorily in a combat mission role.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 45755

46117 **(DOE/CE/50070—T16) DOE Synthetic Fuel Center monthly progress report No. 9, 1-30 July 1986.** Sefer, N.R.; Erwin, J. (Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div.). 10 Aug 1986. Contract AC01-84CE50070. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014165.

The mission of the Synthetic Fuel Center is to provide test quantities of special fuels to the research projects of the Alternative Fuels Utilization Program (AFUP). The fuels have met defined composition and property objectives or have conformed to assesements of future fuel composition. These fuels are produced from diverse sources including shale, coal, tar sands, and petroleum stocks and have included alcohols and vegetable oils. In the first three years of operation, the Center completed the laboratory and pilot plant, provided 26 fuels to 11 AFUP projects, and made two presentations of its work and five roundtable discussions.

36 MATERIALS

REFER ALSO TO CITATION(S) 45587, 45612

46118 **(DOE/ER/45142—3) Very low temperature studies of hyperfine effects in metals.** Weyhmann, W. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Jul 1986. Contract FG02-84ER45142. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013658.

Measurements on $ErRh_4B_4$ and $PrCu_6$ are underway. Progress on equipment is described. No hard data is given. (DLC)

46119 (MLM—3363) Slope formation in physical vapor deposited films when using mechanical masking techniques. Nesslage, G.V. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 25 Jun 1986. Contract AC04-76DP00053. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014265.

Physical vapor deposition of films through an opening in an obscuring body, such as a mechanical deposition mask, will demonstrate a distinct ramp at the edges of the deposit zone as defined by the mask opening. This ramp is a direct function of the size, shape, and location of the vapor source. Evaporation sources using electron beam guns result in minimum ramping; however, some does occur and must be considered in process development. This ramping is modeled in a simplified manner and discussed to provide some understanding of the considerations necessary for natural design limits, particularly in thicker films used in the preparation of some bridge wire devices by evaporation deposition techniques.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 45845, 45848, 45851, 45853, 45854, 45864, 45865, 45868, 45868, 45868, 45886, 45886, 45887, 45888, 45888, 46112, 46166, 46214, 46215, 46215, 46305, 46316, 46316, 46388

46120 (AD-A—167403/5/XAB) Surface attack on metals in the presence of liquid metals. Final report. Beal, R.E. (Amalgamated Technologies, Inc., Scottsdale, AZ (USA)). 10 Apr 1986. 132p. NTIS, PC A07/MF A01.

A study was undertaken to evaluate liquid metals as electrical collectors in contact with solid metal alloys. Surface attack of the liquid metal on the solid metal is expected to be a major challenge to the development of a credible system. Low-melting-temperature metals and alloys of the fusible type are to be utilized for a collector that will operate in the 200-500 F range, with emphasis towards the lower end. Solid metals have been selected for experimental work based on their electrical properties and minimal potential reaction with the candidate liquid-metal alloys. Material properties of both liquid and solid metals were reviewed to identify initial material combinations for evaluation. Thorough literature searches were conducted to obtain as much pertinent physical-property and metallurgical data as possible, prior to actual experimental work. Process and material modelling was adopted to select candidate materials for both solids and liquids. Consideration of practical requirements for the eventual collectors is an integral part of the study. Work effort has concentrated on apparatus construction, evaluation and a program of testing to obtain screening data on materials selected and the chosen test method. Results have identified limitations of the test unit design and maximum current loads under test conditions with experimental current collectors. Candidate electrode materials have been exposed in low-melting fusible alloys for direct-dissolution data.

46121 (AERE-R—11829) Transition and upper shelf fracture toughness properties of an A508 Class 3 PWR nozzle cut-out. Druce, S.G.; Worth, J.H. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Jun 1985. 29p. H.M. Stationery Office, London, price Pound 5.00.

In this work the resistance to ductile and brittle fracture modes in an A508 Class 3 PWR nozzle cut-out has been examined using conventional fracture mechanics tests. Within the transition temperature regime considerable variability in toughness was found with some evidence that the near inside wall position was less tough then close to the outside wall. Cleavage fracture occurred at temperatures up to 60 C and a few data were below the ASME and lower bound reference toughness/temperature lines defined in the 1982 Light Water Reactor Study Group report on pressure vessel integrity. At 290 to 300 C specimen orientation significantly influenced tearing resistance but had little effect on initiation toughness. The observed orientation effects were consistent with an inclusion dominated fracture process. The levels of upper shelf toughness were less than those previously found in a Japanese A508 forging, and similar to those of French A533B Class 1 plate produced about the same time. A comparison is made between the chemical analysis, tensile, Charpy impact, drop weight and fracture toughness properties of this forging and the appropriate ASME and Sizewell B specification.

46122 (AERE-R—11962) Some fundamental studies of metal-induced embrittlement. Trevena, P.; Lynch, S.P. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.; Aeronautical Research Labs., Melbourne (Australia)). Nov 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703155.

A study has been made of the effects of liquid alkali metal environments on the fracture behaviour of nickel, magnesium and single crystals of iron-silicon alloy. Liquid lithium and sodium environments were shown to promote embrittlement of one or more of the solid metals. Fractography revealed ductile dimpling, intergranular and transgranular fracture, the proportions of which varied with environment and test conditions. Liquid metal embrittlement (LME) of nickel and the iron silicon alloy showed remarkable fractographic similarities to hydrogen embrittlement (HE). LME of magnesium revealed features which are similar to fractures induced by stress corrosion cracking (SCC). It is therefore proposed that the mechanisms of LME, HE and SCC are similar in these cases. In addition, double cantilever beam (DCB) test specimens were used to investigate the effect of solid indium on sub-critical crack growth rates of 7017-T651 aluminium alloy.

46123 (AERE-TP—1124) Mathematical model of crevice and pitting corrosion. Pt. 2. The mathematical solution. Sharland, S.M. (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Sep 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703156.

The time-independent equations of mass transport governing the concentration of species and electrode potential within a corroding crevice or pit are solved using a number of mathematical approximations based on physical observations. A variety of analytic and numerical techniques is described and several methods which reduce computing time are developed. A simple method of time stepping is described for a calculation of the effect of precipitation of solid hydroxide in the crevice.

46124 (BNL—38329) Antiferromagnetic spin fluctuations and the heavy fermion system UPt_3. Goldman, A.I.; Shirane, G.; Aeppli, G.; Bucher, E.; Hufnagl, J. (Brookhaven National Lab., Upton, NY (USA); Bell Labs., Murray Hill, NJ (USA); Konstanz Univ. (Germany, F.R.)). 1986. Contract AC02-76CH00016. 11p. (CONF-860746—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014125.

From Anomalous rare earths and actinides; Grenoble, France (7 Jul 1986).

We review the results of inelastic polarized and unpolarized magnetic neutron scattering measurements on the heavy fermion superconductor UPt_3. Below T/sub chi/ = 18K, we find evidence for antiferromagnetic spin fluctuations with a modulation vector along the c-axis of the hexagonal lattice. This contradicts the analogy often made between UPt_3 and liquid ^3He, and may have important consequences for the pairing mechanism responsible for superconductivity in this system.

46125 (CONF-860605—19) Radiation-induced segregation in Cu-Au alloys. Hashimoto, T.; Rehn, L.E.; Okamoto, P.R. (Argonne National Lab., IL (USA). Materials Science and Technology Div.; Hitachi Ltd., Ibaraki (Japan). Energy Research Lab.). Apr 1986. Contract W-31-109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014492.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Radiation-induced segregation in a Cu-1 at. % Au alloy was investigated using in situ Rutherford Backscattering Spectrometry. Irradiation with 1.8-MeV He produced nonequilibrium Au atom depletion in the near surface region. The amount of segregation was measured as a function of dose, dose rate and temperature. Segregation was observed between 300 and 500°C. For a calculated dose rate of 3.9×10^{-5} dpa/s, the radiation-induced segregation rate peaked near 400°C. Theoretical analysis based on the Johnson-Lam model predicted that the amount of segregation would be directly proportional to dose at the early stage of irradiation, would deviate from linearity with a continuously decreasing slope at intermediate

doses, and finally approach a constant value after high doses. The analysis also predicted that the segregation rate would vary as the -1/4th power of the dose rate at constant dose in the low temperature region. These predictions were all verified experimentally. A procedure for extracting relative defect production efficiencies from similar measurements is discussed.

46126 **(CONF-860605—21) Cascade defect production and irradiation enhanced diffusion in Cu_3Au.** Kirk, M.A.; Funk, L.L. (Argonne National Lab., IL (USA)). Mar 1986. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014531.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

By using the ordering alloy Cu_3Au and measuring resistivity changes during and following fast-neutron irradiations at IPNS, we have studied cascade defect production and irradiation enhanced diffusion between 10 and 460°K. Ordering and disordering rates were measured as functions of irradiation temperature, neutron dose, neutron dose rate, time following cessation of flux, and step annealing. Free and clustered vacancy production was observed. The temperature dependence of the production of total migrating vacancy concentrations was determined. Vacancy sink production was linear with neutron dose and is compared with recent transmission electron microscopy experiments on the production of dislocation loops in this alloy. Time dependent and quasi-steady state vacancy concentrations were measured and compared with solutions of reaction rate equations for irradiation enhanced diffusion. The influence of recombination of vacancies with interstitials is observed at low sink concentrations (low neutron doses).

46127 **(CONF-860605—22) Collapse of defect cascades to dislocation loops in Cu_3Au.** Black, T.J.; Jenkins, M.L.; English, C.A.; Kirk, M.A. (Argonne National Lab., IL (USA). Materials Science and Technology Div.; Oxford Univ. (UK); UKAEA Atomic Energy Research Establishment, Harwell). Feb 1986. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014529.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

TEM and ordered Cu_3Au were employed to measure the probability of dislocation loop formation as functions of irradiating ion mass (Ar^+, Cu^+ and Kr^+), energy (50 and 100 keV), and irradiation temperature (30 and 300°K). Disordered zones were produced at every defect cascade site and imaged in dark-field superlattice reflections. Dislocation loops were imaged in fundamental reflections in the same sample areas to produce an accurate measurement of the probability of the collapse of each cascade to a dislocation loop, within a large set (~200) of defect cascades for each irradiation condition. The size distributions of dislocation loops and disordered zones were also measured. Defect cascades collapse to dislocation loops with significant probability (~0.5) even at 30°K. Other observations include an increasing collapse probability with increasing cascade energy density (increasing ion mass) and with increasing sample irradiation temperature. However, no additional collapse was observed upon annealing from 30 to 300°K, and no increase in collapse probability was observed upon increasing the bombarding ion energy from 50 to 100 keV. Disordered zone sizes also increased with increasing ion mass and with increasing sample irradiation temperature (30 to 300°K).

46128 **(CONF-860605—23) Collapse of defect cascades to dislocation loops during self-ion irradiations of Fe, Ni and Cu at 30, 300 and 600°K.** Kirk, M.A.; Robertson, I.M.; Vetrano, J.S.; Jenkins, M.L.; Funk, L.L. (Argonne National Lab., IL (USA). Materials Science and Technology Div.; Illinois Univ., Urbana (USA); Oxford Univ. (UK)). Feb 1986. Contract AC02-76ER01198;W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014530.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

The formation of dislocation loops by self-ion irradiations of Fe, Ni and Cu has been studied in situ in the ANL High-Voltage Electron Microscope as functions of ion dose and irradiation temperature. At low doses ($\leq 10^{13}$ ions/cm^2) at room temperature individual cascades were observed to collapse to vacancy dislocation loops in Cu with high probability, in Ni with lower probability, and in Fe with zero probability. Cascade collapse was observed at low doses at 30°K in Cu and Ni, but at rates less than their respective rates at room temperature. A loop formation rate for Ni at 600°K is also reported. At higher doses ($>10^{13}$ ions/cm^2) where overlap of cascades becomes significant, loops were first observed in Fe and with a supra-linear build-up with dose. Also at higher doses a decrease in loop production rate in Cu and Ni was observed due to loop coalescence. The materials and temperature dependence of cascade collapse probabilities are suggested to be related to thermal spike mechanisms during the cascade formation lifetime.

46129 **(CONF-860605—24) Fine scale microstructure in cast and aged duplex stainless steels investigated by small angle neutron scattering.** Epperson, J.E.; Lin, J.S.; Spooner, S. (Argonne National Lab., IL (USA). Materials Science and Technology Div.; Oak Ridge National Lab., TN (USA). Solid State Div.). Feb 1986. Contract AC05-84OR21400;W-31-109-ENG-38. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014499.

From 13. international symposium on the effects of radiation on materials; Seattle, WA, USA (23 Jun 1986).

Small angle neutron scattering (SANS) allows clustering phenomena to be studied in systems for which the constituent atoms do not differ greatly in atomic number. This investigation used SANS to characterize the fine scale microstructure in two cast and aged duplex stainless steels; aging times extended up to eight years. The steels differed in ferrite content by about a factor of two. The scattering at lowest q was dominated by magnetic scattering effects associated with the ferrite phase. In the range $0.025 \leq q \leq 0.2A^{-1}$, additional scattering due to a precipitating phase rich in Ni and Si was observed. This scattering was rather intense and revealed a volume fraction of precipitate, in the ferrite, estimated to be 12 to 18% after long time aging. After about 70,000 hours at 400°C, there were about 10^{18} precipitate particles per cm^3 some 50A in mean diameter, and they were distributed in a nonrandom manner, i.e., spatially, short-range-ordered. This investigation suggests that after aging some 70,000 hours at 400°C, the precipitate in the ferrite phase is undergoing Ostwald ripening. The present data are insufficient to indicate at what time this ripening process began.

46130 **(CONF-860752—1) Microstructural characterization of primary coolant pipe steel.** Miller, M.K.; Bentley, J. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012631.

From 33. international field emission symposium (IFES); Berlin, F.R. Germany (6 Jul 1986).

Atom probe field-ion microscopy, analytical electron microscopy, and optical microscopy have been used to investigate the changes that occur in the microstructure of cast CF 8 primary coolant pipe stainless steel after long term thermal aging. The cast duplex microstructure consisted of austenite with 15% δ-ferrite. Investigation of the aged material revealed that the ferrite spinodally decomposed into a fine scaled network of α and α'. A fine G-phase precipitate was also observed in the ferrite. The observed degradation in mechanical properties is probably a consequence of the spinodal decomposition in the ferrite.

46131 **(CONF-8609101—1) Microstructural modifications during laser and electron beam welding.** David, S.A.; Vitek, J.M. (Oak Ridge National Lab., TN (USA). Metals and Ceramics Div.). 1986. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011076.

From International conference on power beam technology; Brighton, UK (10 Sep 1986).

Extensive microstructural modifications occur during laser and electron beam welding of various alloys. For austenitic stainless steels, most welds that do not hot crack contain a duplex austenite plus ferrite microstructure when welded by conventional welding processes. However, during laser welding at high speeds, fully austenitic or ferritic microstructures can be obtained in this class of material. The observed modifications in microstructures will be explained in terms of changes in the mode of solidification and also a retardation of solid state transformation. Laser and electron beam welding processes have been successfully used to weld iridium

alloys, which are difficult to weld by conventional welding processes. During welding, these alloys have been found to be prone to severe hot cracking. The cracking is influenced to a great extent by the fusion zone microstructure and composition. The successful laser and electron beam welding of these alloys is attributable to the highly concentrated heat source available, precise control of the heat input, and the refinement in fusion-zone microstructure obtained. The refinement in the fusion-zone microstructure and hence the reduction in hot-cracking tendency of these alloys are discussed in terms of the puddle shapes and grain growth during laser or electron beam welding.

46132 **(DOE/ER/45182—2) Detecting and monitoring crack growth in austenitic and ferritic steels. Progress report, 1 December 1985-30 November 1986.** Carpenter, S.H. (Denver Univ., CO (USA). Dept. of Physics). Jul 1986. Contract FG02-85ER45182. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014348.

The program has been mainly concerned with the use of acoustic emission measurements and signal analysis to detect, monitor and identify the mode of crack growth. Treatments have been developed which produce four distinct and different modes of crack growth in 304 stainless steel. The acoustic emission has been measured from each of these four types of crack growth using cantliver speciments. The waveforms have been recorded and careful analysis is underway to characterize the emissions. It appears that it will be possible to identify the mode of crack growth from characteristics of the measured acoustic emissions.

46133 **(EPRI-CS—4666) Dissimilar-weld failure analysis and development. Comparative behavior of similar and dissimilar welds. Final report.** Busboom, H.; Ring, P.J. (General Electric Co., Sunnyvale, CA (USA). Nuclear Systems Technology Group). Jul 1986. 51p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920418.

The 593°C (1100°F) stress rupture behavior of similar metal welds (SMWs) and dissimilar metal welds (DMWs) was investigated under cyclic load and cyclic temperature conditions to provide insight into the question, "Why do DMWs fail sooner than SMWs in the fossil fuel boilers." The weld joints of interest were an all ferritic steel SMW made by fusion welding 2-1/4Cr-1Mo to 2-1/4Cr-1Mo using 2-1/4Cr-1Mo filler metal and an austenitic to ferritic steel DMW made by fusion welding Alloy-800H to 2-1/4Cr-1Mo using a nickel base filler metal ERNiCr-3. The stress rupture behavior obtained on cross weld specimens was similar for both types of welds with only a 20% reduction in rupture life for the DMW. For rupture times less than 1500 hours, failures occurred in the 2-1/4Cr-1Mo base metal whereas, for rupture times greater than 1500 hours, failures occurred in the 2-1/4Cr-1Mo heat affected zone (HAZ). The HAZ failures exhibited a more brittle appearance than the base metal failures for both types of welds and it appears that the life of both joints was limited by the stress rupture properties of the HAZ. These results support the hypothesis that increased residual stresses due to abrupt changes in hardness (strength) of metals involved are the major contributors to the reduction in life of DMWs as compared to SMWs. 10 refs., 15 figs., 7 tabs.

46134 **(EPRI-CS—4688) Remaining-life estimation of boiler pressure parts: crack growth studies. Final report.** Liaw, P.K.; Saxena, A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Materials Analysis Dept.; Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.). Jul 1986. 119p. Reserach Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920416.

A methodology for predicting the remaining creep crack growth life in boiler thick section components has been developed. The creep crack growth behavior of a 1-1/4Cr-1/2Mo header material can be characterized by the C/sub t/ parameter over a wide range of crack growth rates and under conditions ranging from small-scale to large-scale creep. Limited finite-element results show that C/sub t/, as measured at the loading pins of test specimens, can be used as a measure of the crack tip stress field in the non-steady-state creep regime. This may be the reason that C/sub t/ characterizes creep crack growth behavior. The experimentally measured values of C/sub t/ in compact-type specimens compared well with those obtained from the general analytical equations developed in this program. Analytical equations have been formulated for estimating C/sub t/ in structural components. The creep deformation rates and the creep crack growth rates of the material machines from the hot region of the header were found to be greater than those from the cold region. Varying the specimen diameter from 1.98 to 12.83 mm did not affect creep deformation and rupture data. The developed life prediction methodology is demonstrated by using two hypothetical examples of a cracked header-like component and an elevated-temperature steam pipe. 39 refs., 49 figs., 11 tabs.

46135 **(EPRI-CS—4727) Microstructure and texture effects on titanium alloys.** Luetjering, G. (Technische Univ. Hamburg-Harburg (Germany, F.R.). Bereich Metallkunde und Werkstofftechnik). Aug 1986. 67p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920419.

In support of EPRI's interest in titanium alloy blading for low pressure steam turbines, the Technical University of Hamburg-Harburg has been studying the effects of microstructure and texture of the mechanical properties of a titanim alloy Ti-6A-4V that are important in the low pressure blade applications. These studies are presented in the form of technical papers on the following topics: (1) fatigue; (2) mean stress; (3) shot peening; (4) notch effects; (5) fatigue crack propagation; (6) fracture toughness; (7) structure-property correlation. These papers have appeared individually in the technical literature, but are collected here in a single report to facilitate their use in L.P. steam turbine applications. All papers have been processed for inclusion in the Energy Data Base.

46136 **(EPRI-EM—4568) Electroforming of metals: state-of-the-art assessment. Final report.** Fiorentino, R.J. (Battelle Columbus Div., OH (USA)). Jul 1986. 44p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920402.

An assessment of the state-of-the-art of electromagnetic and electrohydraulic forming of metal parts has been conducted. Electromagnetic forming (EMF) shapes parts by a force resulting from a high-density magnetic field. The electrohydraulic forming (EHF) process differs in that the force is applied to parts from a shock wave emanating from a point within a fluid medium. Both processes are used to form relatively thin-section hollow or flat products. This survey has found that, of the two electrotechnologies, the electromagnetic forming process is expected to be used increasingly in a broad range of industries, particularly for automotive, aircraft, and electrical-cable components. In contrast, the level of applications for the electrohydraulic forming method is expected to remain essentially unchanged over the near- and long-term period. This is because its use is restricted to relatively unusual part shapes in industries that do not require large unit quantities. It is expected that the electricity consumption of the EMF process will increase to levels of 25 and 100 million kWh in 1990 and 2000, respectively. The electricity consumption of the EHF process, however, is negligible by comparison (probably less than 10 percent of that for EMF today) and no future growth is expected.

46137 **(EPRI-RD—4649-Vol.1) Effects of dynamic strain on crack tip chemistry. Volume 1. Tests using a segmented artificial crevice. Final report.** Parkins, R.N.; Liu, Y. (Newcastle upon Tyne Univ. (UK). Dept. of Metallurgy and Engineering Materials). Jun 1986. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI86920438.

Work was done on potential, current and solution composition changes along stress corrosion cracks in a NiCrMoV steel in NaOH solutions and in type 304 stainless steel in NaCl solutions. Surfaces of the steels were exposed to the relevant solution in a creviced situation simulating a crack, the dynamically straining tip of which was simulated by a tensile specimen located at the remote end of the crack. With the 304 stainless steel in dilute chloride solutions, large potential gradients can persist along simulated cracks. Depending upon the solution composition and applied potential, large changes in the pH of the enclave solution can occur and these can be enhanced in the vicinity of the straining tensile specimen simulating the crack tip. Pitting, with associated chloride ion con-

centration changes, can occur on the simulated crack sides, but opening and closing the crack, to displace about 80% of the enclave solution, had little effect upon the potential distribution.

46138 **(EUR—10033-FR) Corrosion resistance of nickel and some nickel base alloys in water electrolyzers working at 200°C. Final report.** Combrade, P. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 90p. (In French). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energie.

The aim of this program was to check the corrosion resistance of Nickel 200, 201 and several nickel base alloys (600, Monel 400) in conditions typical of anolyte circuits in electrolyzers working at 200 or 160°C. A particular emphasis was given to the effect of welding on the corrosion properties. The anolytes were simulated with 40% KOH solutions with oxygen partial pressure from 2 to 18 bar. Conventional exposure tests including welded coupons were performend as well as electrochemical measurements and exposure tests under electrochemical control.

46139 (INIS-mf—10145, pp 38-47) **Some theoretical and experimental aspects of assessing corrosion fatigue of metals.** Valenta, J. (Statni Vyzkumny Ustav pro Stavbu Stroju, Bechovice, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The rate of propagation of corrosion fatigue cracks results from the presence of the aggressive medium and from the synergic effects of cyclic load. The propagation of the fatigue crack under the corrosive medium is modelled by a change of constants in Paris' relationship. The variation of crack propagation rate with the amplitude of the change in the factor of stress intensity is given in diagrams. In austenitic steels of the 18-8 type, it was proved that there exists a threshold temperature of 130 deg C of very pure water under which there is no intergranular stress corrosion cracking. Intergranular stress corrosion cracking has also been indicated in case maximum stress in the cycle is below the yield point if the temperature of the water was 288 deg C. The rate of growth of the corrosion crack in very pure water is approximately by 1.5 orders higher than at room temperature and in the air. The increase in growth rate of the defect when simulating the chemical composition of water in a nuclear power plant, is relatively low. Algorithms have been processed for determining the service life of fast reactor steam generator pipes. A diagram is given representing the test loop which allows to experimentally identify the required characteristics of materials.

46140 (INIS-mf—10145, pp 48-54) **Experimental approach to the study of the effect of sodium on long-term properties.** Walder, V.; Dufek, F.; Prnka, T. (Vyzkumny Ustav Hutnictvi Zeleza, Dobra, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

A special testing equipment was developed for studying the effects of superimposition of mechanical stress and the effect of liquid sodium at high temperatures on structural materials for nuclear power plants. The equipment consists of a dynamic two-circuit sodium loop with a temperature gradient in the main circuit and with forced sodium flow. It comprises a main circuit with the experimental section and with an absorber of corrosion products, and an auxiliary purification circuit with a cold trap. The circuits have a common storage tank, argon economy and vacuum system. The temperature difference between the test pieces and the absorber of corrosion products is at least 100 deg C. The test section consists of six series-connected containers into which test samples of the material are inserted. A diagram is given of the testing equipment and the variation of temperature, velocity and size of active surface along the whole main circuit is shown.

46141 (INIS-mf—10145, pp 71-79) **Effect of long-term operating exposure to sodium and steam-water mixture on creep strength and fatigue properties.** Bina, V.; Douda, J.; Kneifl, M. (Statni Vyzkumny Ustav Materialu, Prague, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

With regard to the manufacture of fast reactor steam generators the following materials were tested: Cr20Ni35Ti (S31), Cr18Ni11 (3R12) and Cr2.25Mo1Nb (HT8X6). Mechanical properties are adequate to values of non-exposed steels. Creep tests showed that at operating temperatures of up to 500 deg C no changes appeared in the refractory properties due to the effects of sodium or the water/steam mixture. The plastic properties (ductility) remained unchanged. Tests of the effect of the water/steam mixture on fatigue showed in Cr2.25Mo1Nb steel a decrease by one order of resistance to high cycle fatigue. This was caused by local corrosion of tubes. For an undisturbed internal surface with compact magnetite layer, the fatigue properties of tubes remained unchanged. Cracks near to the surface have a mixed character with prevalence of intergranular failure.

46142 (INIS-mf—10145, pp 133-144) **Properties of long-term operated welded joints.** Pilous, V. (Vysoka Skola Strojni a Elektrotechnicka, Plzen, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The causes are investigated of cracks under overlays in the heat affected zone of medium alloy Cr-Ni-Mo-V steels. Cracks develop in submerged arc welding with austenitic strip electrodes at a high heat input. At high temperatures 1250 - 1430 deg C, grains in the overheated zone adjoining the austenitic overlay become coarse. Cracks are intergranular, along the original austenitic grains, with smooth intergranular facets. A test was made of simulating cycles of welding and annealing. The samples were heated to a temperature of 1350 deg C for 30 s and subsequently cooled for 30 s to a temperature of 100 - 20 deg C. At constant stress lower than threshold stress and at critical temperature of 500 - 800 deg C no overlay cracks appeared. Also simulated was the consequence of a 5000 h dwell in an operating temperature of 325 deg C. Under cyclic stress the service life of material in the overlay and in the joints with basic material decreased by 5 - 15%. The austenitic overlay showed greater resistance to plastic deformation. Owing to carburization of the boundary of the overlay and basic material, crack propagation in that zone slowed down, in some instances ceased completely.

46143 (INIS-mf—10145, pp 23-30) **Thermodynamics and diffusion processes in the Fe-Ni-Cr system.** Million, B.; Vrestal, J. (Ceskoslovenska Akademie Ved, Brno. Ustav Fyzikalni Metalurgie). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The instance is considered when austenitic steel of the Fe-C-Cr-Ni type comes in contact with flowing liquid sodium at temperatures of 500 - 600 deg C. The self-diffusion coefficients of components were measured for this ternary system. The self-diffusion coefficients increase with iron content increasing from 0 to 15% and decline at an iron content of more than 35%. The ratio of self-diffusion coefficients of the individual components is constant for the entire studied temperature and concentration interval. Using determinations of thermodynamic activities in the binary systems Fe-Ni, Fe-Cr and Ni-Cr it is possible to assess the regrouping of elements in austenitic steels and thereby to estimate the possible long-term changes in the mechanical properties of these materials.

46144 (INIS-mf—10145) **Long-term mechanical properties of steels under effect of corrosive medium. Seminar.** (Vyzkumny Ustav Hutnictvi Zeleza, Dobra (Czechoslovakia)). 1984. 114p. (In Czech). (CONF-8409354—). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157.

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

At the seminar held in Visalaje (Czechoslovakia) in September 1984, the participants heard 19 papers of which 13 have been inputted in INIS. They deal with the problems of thermodynamics and of diffusion in austenitic steels, of corrosion fatigue of metals, structural materials for fast reactor steam generators, of resistance and service life of structural materials, especially in the liquid sodium medium, and of the properties of welded joints and their effect on resistance to long-term stress.

46145 (INIS-mf—10145, pp 3-12) **Selected physical and metallurgical characteristics of austenitic stainless steels used in nuclear power engineering.** Mazanec, K. (Vysoka Skola Banska, Ostrava, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The susceptibility of CrNi austenitic steels to the development of intergranular corrosion cracking is evaluated. Intergranular corrosion develops in dependence on carbon content after annealing at temperatures of 500 - 800 deg C. An important role is played by impurities in the steel. They may modify the rate of corrosion or passivation or influence the C-Cr balance at the grain boundaries, which leads to changes in kinetics and in thermodynamic parameters of the precipitation of chromium carbides. Intergranular defects have also been found during the development of what are called warm cracks in the weld metal which are related to the segregation of phosphorus and sulfur. Methods are indicated of controlling the microsegregation processes of various additions and of eliminating the effects of annealing and other metallurgical parameters on the said processes.

46146 (INIS-mf—10145, pp 120-124) **Effect of reactor environment on embrittlement of Cr-Mo-V steel.** Splichal, K.; Axamit, R.; Otruba, J.; Koutsky, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez, Czechoslovakia). 1984. (In Czech). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703157. (CONF-8409354—).

From Seminar on long-term mechanical properties of steels under effect of corrosive medium; Visalaje, Czechoslovakia (26 Sep 1984).

The effects are studied of neutron radiation, applied strain and corrosion medium on the propagation of corrosion cracks in the materials of PWR pressure vessels. Tested were low alloy steels Cr-Mo-V and Cr-Ni-Mo-V. Tensile properties were tested on cylindrical samples with the diameter d=4 mm at the deformation rate 8.3×10^{-4} s^{-1}. Cylindrical samples with a 60 deg V notch, diameters d_1=3.5 mm, d_2=5 mm, l=17.5 mm and notch radius 0.5 mm were tested at constant load. Irradiation was carried out on the WWR-S reactor with neutron fluence 2.6 to 4.9×10^{23} $n.m^{-2}$ (E>0.5 MeV) at temperatures 130, 180 and 290 deg C. Irradiated and non-irradiated samples were charged with hydrogen in 1N H_2SO_4 for one hour before the test. The experiment determined the value of threshold stress under which samples of steel are not disturbed even at high current densities: for Cr-Mo-V steel, this is 210 MPa, for Cr-Ni-Mo-V it is 410 MPa. The susceptibility of unirradiated steel to hydrogen embrittlement following hydrogen charging occurs at a hydrogen content of over 2.5 ppm. The effect of radiation embrittlement on hydrogen embrittlement is indirectly proportional to the irradiation temperature. Hydrogen charging of samples irradiated at 130 and 180 deg C with a fluence greater than 2.6×10^{23} $n.m^{-2}$ leads to the superposition of hydrogen and radiation embrittlement thereby often resulting in total loss of plasticity.

46147 (JAERI-M—85-053) **Influence of heating rate on corrosion behavior of Ni-base heat resistant alloys in simulated VHTR helium environment.** Kurata, Yuji; Kondo, Tatsuo. (Japan Atomic Energy Research Inst., Tokyo; Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Apr 1985. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. File Number DE86703158.

The influence of heating rate on corrosion and carbon transfer was studied for Ni-base heat resistant alloys exposed to simulated VHTR(very high temperature reactor) coolant environment. Special attention was focused to relationship between oxidation and carburization at early stage of exposure. Tests were conducted on two heats of Hastelloy XR with different boron(B) content and the developmental alloys, 113MA and KSN. Two kinds of heating rates, i.e. 80 °C/min and 2 °C/min, were employed. Corrosion tests were carried out at 900 °C up to 500 h in JAERI Type B helium, one of the simulated VHTR primary coolant specifications. Under higher heating rate, oxidation resistance of both heats of Hastelloy XR (2.8 ppmB and 40 ppmB) were equivalent and among the best, then KSN and 113MA followed in that order. Under lower heating rate only alloy, i.e. Hastelloy XR with 2.8 ppmB, showed some deteriorated oxidation resistance while all others were unaffected by the heating rate. On the other hand the carbon transfer behavior showed strong dependence on the heating rate. In case of higher heating rate, significant carburization occurred at early stage of exposure and thereafter the progress of carburization was slow in all the alloys. On the other hand only slow carburization was the case throughout the exposure in case of lower heating rate. The carburization in VHTR helium environment was interpreted as to be affected by oxide film formation in the early stage of exposure. The carbon pick-up was largest in Hastelloy XR with 40 ppmB and it was followed by Hastelloy XR with 2.8 ppmB. 113MA and KSN were carburized only slightly. The observed difference of carbon pick-up among the alloys tested was interpreted to be attributed mainly to the difference of the carbon activity, the carbide precipitation characteristics among the alloys tested.

46148 (N—86-24818) **Thermal-mechanical fatigue behavior of nickel-base superalloys. Final Report.** Pelloux, R.M.; Marchand, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Mar 1986. 186p. (NASA-CR—175048; USAAVSCOM-TR—86-C-4). NTIS, PC A09/MF A01.

The main achievements of a 36-month research program are presented. The main objective was to gain more insight into the problem of crack growth under thermal mechanical fatigue (TMF) conditions. This program was conducted at M.I.T. for the period of September 1982 to September 1985. The program was arranged into five technical tasks. Under Task I, the literature of TMF data was reviewed. The goal was to identify the crack propagation conditions in aircraft engines (hot section) and to assess the validity of conventional fracture mechanics parameters to address TMF crack growth. The second task defined the test facilities, test specimen and the testing conditions needed to establish the effectiveness of data correlation parameters identified in Task I. Three materials (Inconel X-750, Hastelloy-X, and B-1900) were chosen for the program. Task II was accomplished in collaboration with Pratt & Whitney Aircraft engineers. Under Task III, a computerized testing system to measure the TMF behavior (LCF and CG behaviors) of various alloys systems was built. The software used to run isothermal and TMF tests was also developed. Built around a conventional servohydraulic machine, the system is capable of push-pull tests under stress or strain and temperature controlled conditions in the temperature range of 25C to 1050C. A crack propagation test program was defined and conducted under Task IV. The test variables included strain range, strain rate (frequency) and temperature. Task V correlated and generalized the Task IV data for isothermal and variable temperature conditions so that several crack propagation parameters could be compared and evaluated. The structural damage (mode of cracking and dislocation substructure) under TMF cycling was identified and contrasted with the isothermal damage to achieve a sound fundamental mechanistic understanding of TMF.

46149 (N—86-25453) Tensile behavior of Fe-40Al alloys with B and Zr additions. Gaydosh, D.J.; Nathal, M.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 27p. (NASA-TM—87290; E—2997; CONF-860340—7). NTIS, PC A03/MF A01.

From 115. American Institute of Mining, Metallurgical and Petroleum Engineers annual meeting; New Orleans, LA, USA (2 Mar 1986).

Both Fe-40Al and Fe-40Al-0.1Zr with and without B were produced by the hot extrusion of powdered metal. Tensile properties were determined from room temperature to 1100 K in air. All of the materials possessed some ductility at room temperature, and addition of B caused an increase in ductility and a change in fracture mode from intergranular to transgranular cleavage. At high temperatures, failure was caused primarily by the formation of grain boundary cavities in all of the alloys. The effect of Zr addition was unclear because of the complexity of the various microstructures. Comparison of air and vacuum testing at high temperatures revealed that an apparent oxidation assisted mechanism reduced high temperature ductility in these alloys, especially at 900 K.

46150 (PPA-FR—2) Effects of time, temperature and rotation of water on the corrosion rate of different types of steels. Muhamad Daud; Jamaliah Shariff. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). 1984. 34p. Nuclear Energy Unit, Bangi, 43000 Kajang, Malaysia.

By using hot plate/magnetic stirrer and immersion technique, the steel corroded uniformly and their corrosion rates vary due to type of steel, time of immersion, temperature and rotation of water. Therefore, the rate of general corrosion, or sealing, of steel alloys is influenced by a number of factors, those best established being the composition of the metal, time, temperature, velocity, cleanliness or roughness of the metal surface and direct contact with solutions of the other materials.

46151 (PPA-T—29) Creep fatigue behaviours of stainless steel (316-SS) at elevated temperatures. Abdul Aziz Mohamed. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). [1986]. 21p. Nuclear Energy Unit, Bangi, 43000 Kajang, Malaysia.

The aim of this work was to study the influence of fatigue and heat-treatment on the creep property of stainless steel-316 at temperatures range 750 to 860 deg C. The work had shown that mechanism of creep process was probably a combination reaction between dislocation intersection and solute drag creep deformation. At high temperatures (>800 deg C) and high stresses (>100 Mpa), the activation energy of as-received specimen was 318 kJ per mol. The stress exponent value was 7.6. The C constant of larson-miller equation is 16.9.

46152 (SAND—86-0809C) Formation of icosahedral Al-Mn and Al-Ru by solid-state processes. Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 22p. (CONF-860702—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014146.

From 5. international conference on surface modification of metals by ion beams; Kingston, Ontario, Canada (7 Jul 1986).

We have used ion beam mixing and solid-state interdiffusion of interdigitated Al/Mn or Al/Ru layers to form icosahedral surface alloys in the solid state. Higher temperatures are required to form the icosahedral phase in Al-Ru than in Al-Mn, both with mixing (300°C versus 150°C) and by interdiffusion (400°C versus 300°C). Annealing to higher temperatures produces a transformation to more stable crystalline phases. Formation by these techniques indicated that these icosahedral phases nucleate and grow in the solid state in preference to crystalline phases of lower free energy.

46153 (SAND—86-8231) Mechanical tests on aluminum alloys AMg6 and 5456-0. Kawahara, W.A.; Totten, J.J.; Korellis, J.S. (Sandia National Labs., Livermore, CA (USA)). Aug 1986. Contract AC04-76DR00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014746.

This is a compilation of a preliminary series of mechanical tests performed on specimens extracted from 0.2 in. (5 mm) thick plates of annealed alloy AMg6 and its nearest US equivalent, 5456-0 at room temperature. Included are in-plane tensile data on strain rate sensitivity, quasistatic notched behavior and post-shock properties, and one attempt at spall suppression by back-surface hole drilling.

46154 Angular dependence of ultrasonic wave propagation in a stressed, orthorhombic continuum: Theory and application to the measurement of stress and texture. Thompson, R.B.; Lee, S.S.; Smith, J.F. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of the Acoustical Society of America;* **80**: No. 3, 921-931(Sep 1986).

A theory for ultrasonic wave propagation in a symmetry plane of a biaxially stressed, orthorhombic continuum is presented. Since many of the material parameters which appear in the analysis are unknown, in particular the third-order elastic constants of polycrystalline metals, emphasis is placed on the angular dependence of the velocities. An expansion to first order in stress-induced anisotropy and to second order in textural anisotropy reveals terms with twofold, fourfold, and sixfold symmetry. Scenarios are proposed for using various properties of this symmetry to deduce the difference in magnitude and directions of the principal stresses independent of textural anisotropy and the textural anisotropy independent of the stresses. Experimental results are presented for the cases of aluminum, 304 stainless steel, and copper.

46155 Surface and bulk electronic structure of Ge(111) c-italic(2 x 8) and Ge(111):As 1 x 1. Bringans, R.D.; Uhrberg, R.I.G.; Bachrach, R.Z. (Xerox Corporation, Palo Alto Research Center, 3333 Coyote Hill Road, Palo Alto, California 94304). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2373-2380(15 Aug 1986).

The surface band dispersion of the annealed (111) surface of germanium has been determined experimentally using angle-resolved photoemission. The c-italic(2 x 8) symmetry seen in low-energy electron diffraction is not seen in the surface-state dispersion, which exhibits a 2 x 2 periodicity. This result is interpreted as indicating that the Ge(111) c-italic(2 x 8) surface unit cell contains 2 x 2 subunits. The surface-state dispersion and bandwidth are consistent with a 2 x 2 adatom model for the surface. An examination is made of the effect of the surface on the near-surface electronic structure. Results for the heavily reconstructed Ge(111) c-italic(2 x 8) surface are compared with those for the Ge(111):As 1 x 1 surface. This latter surface was chosen for comparison because the arsenic termination removes the reconstruction and leads to an extremely stable surface with a geometry close to that of an ideal (111) surface. Spectral features corresponding to bulk initial states were compared with calculated values and found to agree throughout most of the surface Brillouin zone. Discrepancies were found near K-bar and attributed to the effect of back-bond formation. At finite values of k-italic/sub X/, a free-electron parabola with its zero at 9.70 eV below the top of the bulk valence band is the final state which best explains the bulk data. At normal emission, on the other hand, a Bloch conduction-band state was found to be more appropriate. The effect of secondary cone emission on the photoemission is discussed.

46156 Structure and magnetism of quasicrystalline and crystalline Al/sub 1-//sub x-italic/Mn/sub x-italic/ alloys. Youngquist, S.E.; Miceli, P.F.; Wiesler, D.G.; Zabel, H.; Fraser, H.L. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2960-2962(15 Aug 1986). Contract AC02-76ER01198.

We have performed x-ray structural studies of quenched and annealed Al/sub 1-//sub x-italic/Mn/sub x-italic/ alloys in the range of 0.14< or =x-italic< or =0.20. The quenched samples exhibit a coexistence of Al with an icosahedral phase, the latter having a maximum volume fraction at x-italic = 0.20. Magnetic susceptibility measurements for x-italic = 0.14 and 0.20 show a dramatically enhanced magnetic moment in the icosahedral phase (p-italic = 0.747 and 1.27, respectively) as compared to the annealed

samples (p-italic = 0 and 0.617, respectively). The increase of magnetic moment per Mn ion with increasing Mn concentration indicates a range of stoichiometries and microstructures over which the icosahedral phase can exist.

46157 **Final-state screening of core holes in metals.** Weinert, M.; Davenport, J.W.; Watson, R.E. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2971-2974(15 Aug 1986). Contract AC02-76CH00016.

Core-level photoemission is often employed to extract chemical information concerning the atomic site and this requires assumptions concerning the balance between initial-state chemical and final-state screening effects. With this in mind, we have calculated the binding energy of the 4f-italic level in gold metal using local-density total-energy calculations. We find a binding energy of 83.7 eV in good agreement with the experimental value of 83.9 eV. We are thus able to test several less complete computational schemes. For example, confining the response to a single site yields 84.3 eV, an error of 0.6 eV, while limiting the screening to the atom and its near neighbors produces an error of 0.07 eV. In additions, we have calculated the heat of solution of mercury in gold. This may be related via a Born-Haber cycle to the core-level binding energy assuming local screening and the equivalent core approximation. This yields a binding-energy error of 0.15 eV, which, while small, is of significance. Finally, we have explicitly decomposed the binding energy into initial- and final-state contributions and find a relaxation energy in gold of 17.7 eV compared to 13.1 eV for the isolated atom.

46158 **Relative concentration measurements of Mn and Mn^+ in a gas tungsten welding arc using laser-induced fluorescence.** Synder, S.C. (EG&G Idaho, Inc., Idaho National Engineering Laboratory, Idaho Falls, Idaho 83415). *Applied Optics;* **25**: No. 14, 2248-2248(15 Jul 1986). Contract AC07-76ID01570.

Lasar-induced fluorescence is used to determine the distribution of relative concentration to neutral and singly ionized manganese in the interfacial zone of a gas tungsten arc over a molten pool of type 304 stainless steel. (AIP)

46159 **Pressure dependence of spin-fluctuation effects in the specific heat of the heavy-fermion superconductor UPt_3.** Brodale, G.E.; Fisher, R.A.; Phillips, N.E.; Stewart, G.R.; Giorgi, A.L. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **57**: No. 2, 234-237(14 Jul 1986). Contract AC03-76SF00098.

UPt_3 is a heavy-fermion superconductor with indications of coexisting long-range ferromagnetic spin fluctuations. Measurements of its specific heat at pressures of 0, 3.8, and 8.9 kbar between 0.35 and 20 K show that the spin-fluctuation terms are extremely sensitive to pressure: the linear term decreases by —25% at 8.9 kbar; the T-italic^3 and T-italic^5 lnT-italic terms decrease by factors of the order of 4. Comparison with the pressure dependence of the critical temperature suggests that the superconductivity is of a form that is e-italicn-italich-italica-italicn-italicc-italice-italicd-italic by spin fluctuations.

46160 **Comment on "Low-energy excitations in α- and γ-Ce observed by photoemission".** Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **57**: No. 2, 269-269(14 Jul 1986). Contract AC05-84OR21400.

A Comment on the Letter by F. Patthey e-italict-italic a-italicl-italic., Phys. Rev. Lett. 55, 1518 (1985).

46161 **Differential anomalous-x-ray-scattering study of icosahedral and amorphous Pd/sub 58.8/U/sub 20.6/Si/sub 20.6/.** Kofalt, D.D.; Nanao, S.; Egami, T.; Wong, K.M.; Poon, S.J. (Department of Materials Science and Engineering and Laboratory for Research on the Structure of Matter, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review Letters;* **57**: No. 1, 114-117(7 Jul 1986).

The total and differential atomic pair-correlation functions of an icosahedral (quasicrystalline) solid were determined for the first time, directly by the differential anomalous-x-ray-scattering technique using synchrotron radiation. The observed atomic distances involving uranium atoms in icosahedral Pd/sub 58.8/U/sub 20.6/Si/sub 20.6/ suggest the presence of a quasicrystalline sublattice with vertex decoration. The pair distribution functions in the icosahedral and amorphous phases are similar up to the second-nearest neighbors, or up to 6 A-circle.

46162 **Wave-vector— and magnetic-field—dependent spin fluctuations in the heavy-fermion system $CeCu_6$.** Aeppli, G.; Yoshizawa, H.; Endoh, Y.; Bucher, E.; Hufnagl, J.; Onuki, Y.; Komatsubara, T. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **57**: No. 1, 122-125(7 Jul 1986).

We have performed neutron-scattering measurements on a single crystal of $CeCu_6$ in applied magnetic fields from 0 to 6.4 T. The observed momentum-dependent magnetic scattering implies the existence of short-range antiferromagnetic correlations. While it induces no resonances, the field broadens the spectra considerably at T-italic = 0.4 K. An effective Hamiltonian which incorporates both single-impurity Kondo properties and antiferromagnetic Ruderman-Kittel-Kasuya-Yosida interactions describes our data.

46163 **Direct observation of spin waves above T-italic/sub C/ for nickel.** Mook, H.A.; Lynn, J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **57**: No. 1, 150-153(7 Jul 1986). Contract AC05-84OR21400.

Inelastic-neutron-scattering measurements with the constant-q technique have been used to characterize the energy response of the scattering in paramagnetic nickel. At small wave vectors q, the scattering peaks at zero energy, indicative of spin diffusion, but at larger q the scattering maximizes at finite +- E-italic demonstrating that the spectral response has propagating character. The relative width ΔE-italic/E-italic of the excitation decreases with increasing chemical bondqchemical bond as expected, with the excitation becoming well defined as its energy becomes comparable with k-italicT-italic.

46164 **Reactions at the Ni-ZrO_2 interface.** Shinde, S.L.; Reimanis, I.E.; DeJonghe, L.C. pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The degradation of metal-ceramic interface at elevated temperatures in protective ceramic coatings limits their life-time. A model system of nickel particles dispersed in a zirconia matrix is used to resolve these changes. Oxidation at elevated temperatures (900°C) leads to NiO growth at the interface. The matrix is destabilized when the stabilizer is soluble in NiO, resulting in transformation to deleterious monoclinic phase which is found to be one important reason for interface degradation.

46165 **Th-U (thorium-uranium) system.** Peterson, D.E. (Los Alamos National Lab., NM). *Bulletin of Alloy Phase Diagrams;* **6**: No. 5, 443-445(1985).

The phase behavior of the Th-U system was studied by a variety of techniques, including X-ray, electrical, resistivity, thermal, and metallographic measurements. The assessed Th-U phase diagram is shown. The system has monotectic, eutectic, and catatectic reactions. No intermetallic compounds are formed, but both Th and U display allotropic transformations. There is significant solubility of U in (Th), whereas the Th solubility in (U) is extremely low. A wide miscibility gap containing two liquids exists at high temperatures.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 45589, 45589, 45758, 45968, 45980, 46097, 46101, 46113, 46164, 46370

46166 (AD-A—167864/8/XAB) Mold and crucible coatings. Final report, April 1984-December 1985. Canino, S.J.; Geary, A.L. (Nuclear Metals, Inc., Concord, MA (USA)). 28 Apr 1986. 83p. NTIS, PC A05/MF A01.

This report details the investigation of coating materials and their application to the graphite crucible and molds used in melting and casting DU-0.75 Ti Alloy. Different types of washes were investigated: zirconium oxide, zirconium silicate, yttrium oxide, titanium carbide (used as an undercoat), and boron nitride. The parameters investigated in the application of these coatings were number of burnouts of the crucible, method of cleaning, surface condition of the crucible, temperature of the crucible during painting, number and time between coats, and method of drying the crucible. The method of applying the wash affects its adherence to the graphite. The more thorough the drying of the first coat, the more effectively the coating protects the crucible. Drying in still air was detrimental to the success of most washes. Both oven or vacuum drying of the coated crucibles improved the adherence of most washes. Performance of yttrium oxide washes was dependent on the physical properties of the CMC binders. Yttria coating of the molds improved ingot surface quality, compared with zirconia coated or uncoated molds. Generally, zirconium oxide washes outperformed titanium carbide under coated systems and yttrium oxide washes in the elevated temperature tests and in chemistry and ultrasonic results.

46167 (AERE-R—1763) Impurity diffusion in NiO grain boundaries. Atkinson, A.; Taylor, R.I. (UKAEA Atomic Energy Research Establishment, Harwell). Apr 1985. 30p. Issuing Activity.

The diffusion of Ce-139 and Cr-51 in polycrystalline NiO has been studied in the temperature range 600-1100C in oxygen at a pressure of 1 atm. These impurities were chosen because of their different effective charges and segregation behaviour and because of their relevance to the oxidation of metals at elevated temperature. The solubility of Ce in the NiO lattice is negligible, but Ce is soluble at NiO grain boundaries and dislocations. Consequently Ce tracer only diffused along these pathways and the resulting profiles were analysed straightforwardly to give grain boundary and dislocation diffusion coefficients. The lattice solubility of Cr, on the other hand, is not negligible and Cr also segregates strongly to NiO grain boundaries. A procedure for analysing penetration profiles of such an impurity has been developed in which parameters describing segregation and grain boundary diffusion are deduced self-consistently. When combined with previous measurements of Ni and Co diffusion it is found that grain boundary coefficients decrease in the order Co, Ni, Cr, Ce as is also found for lattice diffusion (except for Ce, which has negligible lattice solubility). The implication of the results for the distribution of Cr and Ce in NiO films formed by metal oxidation is discussed.

46168 (AERE-R—11942) Effects of temperature and irradiation on piezoelectric acoustic transducers and materials. Broomfield, G.H. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Dec 1985. 32p. H.M. Stationery Office, London, price Pound 5.00.

This report comprises a compilation of lecture notes on the testing, selection and application of materials for piezoelectric acoustic transducers. The construction of high frequency transducers and the effects of irradiation and temperature on types designed for arduous service are described. The criteria for assessing piezoelectric materials are given as a preamble to a brief discussion of the effects on them of temperature and irradiation. These materials include the powder-route ceramics, lead metaniobate and lead-zirconate-titanate and the single crystal materials, quartz, tourmaline, lithium niobate and strontium niobate. Conclusions on the materials are concerned with the probable future temperature ranges for their applications.

46169 (CONF-8609120—1) Use of ammonolytic intermediates for the synthesis of nitrides and carbonitrides. Maya, L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013402.

From NATO workshop on the design, activation and transformation of organometallics into common and exotic materials; Cape d'Agde, France (! Sep 1986).

Liquid ammonia has been used as a reaction medium in which inorganic moieties such as metal halides or hydrides undergo total or partial ammonolysis to produce intermediates which can be converted into precursors of ceramic materials through reactions that utilize the residual halogen for substitution by additional amide ligands or acetylide. The precursors obtained in this manner have a relatively high metal content and readily convert into nitrides or carbonitrides at ≦800°C. Systems examined include aluminum hydride, titanium IV bromide, titanium III chloride and niobium V bromide.

46170 (DOE/ER/45097—T2) Point defect clusters and electrical behavior in transition metal oxides. Progress report. Cohen, J.B.; Ellis, D.E.; Mason, T.O. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering). 15 Nov 1985. Contract FG02-84ER45097. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86009224.

Electrical properties, defect structures, and electronic structure were studied for such oxides as these of Mn, Co, Fe, Zr, Th, etc. (DLC)

46171 (N—86-24836) Improved consolidation of silicon carbide. Freedman, M.R.; Millard, M.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 14p. (NASA-TM—87243; E—2921; CONF-860152—4). NTIS, PC A02/MF A01.

From 10. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (19 Jan 1986).

Alpha silicon carbide powder was consolidated by both dry and wet methods. Dry pressing in a double acting steel die yielded sintered test bars with an average flexural strength of 235.6 MPa with a critical flaw size of approximately 100 micro m. An aqueous slurry pressing technique produced sintered test bars with an average flexural strength of 440.8 MPa with a critical flaw size of approximately 25 micro m. Image analysis revealed a reduction in both pore area and pore size distribution in the slurry pressed sintered test bars. The improvements in the slurry pressed material properties are discussed in terms of reduced agglomeration and improved particle packing during consolidation.

46172 (N—86-24839) Particle size reduction of Si_3N_4 with Si_3N_4 milling hardware. Herbell, T.P.; Freedman, M.R.; Kiser, J.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 19p. (NASA-TM—86864-REV; E—2328-1; CONF-860152—5). NTIS, PC A02/MF A01.

From 10. annual conference on composites and advanced ceramic materials; Cocoa Beach, FL, USA (19 Jan 1986).

The grinding of Si_3N_4 powder using reaction bonded Si_3N_4 attrition, vibratory, and ball mills with Si_3N_4 media was examined. The rate of particle size reduction and the change in the chemical composition of the powder were determined in order to compare the grinding efficiency and the increase in impurity content resulting from mill and media wear for each technique. Attrition and vibratory milling exhibited rates of specific surface area increase that were approximately eight times that observed in ball milling. Vibratory milling introduced the greatest impurity pickup.

46173 (N—86-25267) Compensation in epitaxial cubic SiC films. Segall, B.; Alterovitz, S.A.; Haugland, E.J.; Matus, L.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1986. 12p. (NASA-TM—87269; E—2918). NTIS, PC A02/MF A01.

Hall measurements on four n-type cubic SiC films epitaxially grown by chemical vapor deposition on SiC substrates are report-

ed. The temperature dependent carrier concentrations indicate that the samples are highly compensated. Donor ionization energies, E/sub D/, are less than one half the values previously reported. The values for E/sub D/ and the donor concentration N/sub D/, combined with results for small bulk platelets with nitrogen donors, suggest the relation E/sub D/ (N/sub D/) = E/sub D/(O) - alpha N/sub N//sup 1/3/ for cubic SiC. A curve fit gives alpha is approx 2.6x10/5 meV cm and E/sub D/ (O) approx 48 meV, which is the generally accepted value of E/sub D/(O) for nitrogen donors in cubic SiC.

46174 **(PNL—5915) Evaluation of Synroc-C as a second-generation waste form.** Shade, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014818.

The durability of a crystalline titanate waste form, Synroc-C, was evaluated as a second-generation waste form by leach testing. Tests using both monolith and high surface area powdered samples were used with silicate water and brines at 90°C and 150°C for up to 90 days. In addition, low surface area-to-volume ratio, 1-day leach tests were conducted between 90°C and 250°C to determine forward-direction leach rates and activation energies. Dissolution rates of Cs, Mo, Ba, and U indicated that Synroc-C generally performed about an order of magntidue better than uranium-doped 76-68 glass. The release of Cs and Mo from Synroc-C, at least initially, may be primarily from intergranular regions of the material. The activation energy for the release of these elements from glass was about 9 kcal/mol but less than 3 kcal/mol for Synroc-C. In long-term tests, uranium dissolution may be controlled more by the formation of uranium alteration products than by release from the waste form.

46175 **Electronic structure of the (2 x 2)C-italic rho4g-italic carbidic phase on Ni{100}.** McConville, C.F.; Woodruff, D.P.; Kevan, S.D.; Weinert, M.; Davenport, J.W. (Physics Department, University of Warwick, Coventry CV47AL, England, United Kingdom). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2199-2206(15 Aug 1986).

Angle-resolved photoemission measurements of the valence-electronic structure of the Ni{100}(2 x 2)C structure are compared with the results of self-consistent density-functional calculations of the two-dimensional band structure for a c-italic(2 x 2)C overlayer on Ni{100}. Good agreement is found for the energies of the main C 2p-italic— and C 2s-italic—related features at Gamma-bar and the computed dispersion is similar to, but somewhat greater than, that observed experimentally. These experimental features map in the c-italic(2 x 2) surface Brillouin zone defined by the carbon overlayer, and not the (2 x 2) zone of the surface reconstruction. Changes in the d-italic band structure are attributed to this reconstruction and are not found in the calculated bands or in experiments on a c-italic(2 x 2)O overlayer, both of which involve unreconstructed surfaces.

46176 **Dispersion of surface polaritons in uniaxial Al_2O_3.** Chu, Y.T.; Bates, J.B. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2757-2761(15 Aug 1986). Contract AC05-84OR21400.

The dispersion of ordinary and extraordinary surface polaritons in uniaxial Al_2O_3 crystals has been measured with use of the attenuated-total-reflection method. Some additional reflectivity minima are observed, which are not associated with the excitation of surface polaritons, but are due to the low-reflectivity regions bounded by the optical-phonon-mode frequencies and the bulk-polariton dispersion curve. The discrepancies among the theoretical surface-polariton dispersion curves calculated with the use of various methods are discussed.

46177 **Factors influencing the stability of the tetragonal form of zirconia.** Srinivasan, R.; De Angelis, R.; Davis, B.H. (Department of Metallurgical Engineering and Materials Science, University of Kentucky, Lexington, Kentucky 40506). *Journal of Materials Research;* 1: No. 4, 583-588(Jul 1986).

The p-italicH of the solution that zirconia is precipitated from defines the crystal phase formed after calcination of the material at 400 ° to 600 °C. A metastable tetragonal form is obtained for either low (less than about 5) or high (greater than about 13) p-italicH. The tetragonal phase formed at high p-italicH is much more stable at the calcination temperature than the material obtained at a low p-italicH is. For a material obtained by precipitation at a low p-italicH, monoclinic crystallites, determined by x-ray line broadening, were obtained that were smaller than the tetragonal crystals that produced them. A crystallite size effect, based on x-ray line broadening, is not responsible for the formation or stabilization of the tetragonal phase.

46178 **Crystal structure of SiB_6.** Vlasse, M.; Slack, G.A.; Garbauskas, M.; Kasper, J.S.; Viala, J.C. (Polytechnic Institute of New York, Brooklyn). *Journal of Solid State Chemistry;* 63: No. 1, 31-45(Jun 1986).

The accurate and detailed structure of the compound SiB_6 has been determined by single-crystal X-ray diffraction. The final R value was 6.1% for 4225 reflections. The cell is orthorhombic with space group Pnnm and a = 14.397(7) A, b = 18.318(9) A, c = 9.911(7) A, and from the electron density appears to contain 43 silicon atoms and 238 boron atoms. The structure contains many features found in other structures of boron-rich phases, and obeys the crystal chemistry rules established for them. It contains interconnected icosahedra, icosihexahedra, as well as several isolated boron and silicon atoms. An unusual feature of this structure is the presence of icosihexahedra containing silicon atoms similar to those found previously in BeB_6.

46179 **(N—86-25420) Manufacture of sintered silicon nitrides.** Iwai, T. (National Aeronautics and Space Administration, Washington, DC (USA)). Oct 1985. Translated from Japanese Patent no. 5988373 (Appl. no. 58169291, 1-3(23 Apr 1981). (NASA-TM—77927). 10p. NTIS, PC A02/MF A01.

Sintered silicon nitrides are manufactured by sintering Si_3N powder containing 2 to 15% in wt of a powder mixture composed of nitride powder of lanthanide or Y 100 parts and AlN powder less than 100 parts at 1500 to 1900 deg. temperature under a pressure of less than 200 Kg/sq. cm. The sintered Si_3N has high mechanical strength in high temperature. Thus, Si_3N_4 93.0, Y 5.0 and AlN 2.0% in weight were wet mixed in acetone in N atom, molded and sintered at 1750 deg. and 1000 Kg/sq. cm. to give a sintered body having high hardness.

46180 **Intermixing at Ni-porous zirconia junctions.** Reimanis, I.; DeJonghe, L.C.; Shinde, S. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

When nickel is diffusion-bonded to porous zirconia, a distributed interface may form consisting of nickel particles filling pores in the zirconia. The mechanism of formation and the parameters influencing the structure and mechanical properties of the resultant distributed interface are discussed.

46181 **A TEM study of Ti induced grain growth and precipitation in hot pressed alumina.** Jayaram, V.; Evans, A.G. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Coarse grained inhomogeneities in alumina have been examined in the TEM. X-ray analyses of Mg, Ti and Ni are used to explain the formation of coarse grains and the precipitation sequence that follows annealing. The implications of these results for the observed creep rupture behavior will be discussed.

46182 Characterization of silicon carbide and nitride powder surfaces. Rahaman, M.N.; Boiteux, Y.; DeLohgne, L.C. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The surfaces of SiC and Si_3N_4 powders have been characterized using high resolution TEM, XPS and SIMS techniques. XPS is shown to be a powerful technique once a valid means of referencing the peaks is found. Attempts to manipulate the silica layer and its effect on surface properties are discussed.

46183 Sintered alpha silicon carbide ceramics for high temperature structural application - Status review and recent developments. Storm, R.S.; Boecker, W.D.G.; Mcmurtry, C.H.; Srinivasan, M. (Sohio Engineered Materials Co., Niagara Falls, NY). pp 9 of Beijing international gas turbine symposium and exposition. Beijing, China; Chinese Society of Aeronautics and Astronautics (1985). (CONF-8509221—).

From Beijing international gas turbine symposium and exposition; Beijing, China (1 Sep 1985).

The physical properties of sintered alpha silicon carbide are reviewed, including the effect of oxidation at high temperatures. Net shape fabricated components are described which have undergone extensive testing in heat engine applications. Properties of an SiC/TiB_2 composite material, which has significantly improved fracture toughness, are presented. 20 references.

3603 Composite Materials

46184 (AD-A—167878/8/XAB) Characterization of ion-implanted and laser-processed wear surfaces. Final report, 1 December 1984-28 February 1986. Dillich, S.A. (Worcester Polytechnic Inst., MA (USA). Dept. of Mechanical Engineering). 22 Apr 1986. 52p. NTIS, PC A04/MF A01.

SEM/EDX (Scanning Electron Microscopy/Energy Dispersing X Ray Analysis) and scanning Auger microscope analysis were employed to characterize wear surfaces and debris on friction tested, laser-processed metal-carbide composite surfaces. The friction and wear of the composite samples were found to be influenced by the compatibility (degree of mutual solubility) of the carbides with the steel counterface, as well as by local inhomogeneities in the carbide distribution. High-fluence Ti implantation resulted in increased friction and wear, possibly due to an implantation-induced softening or degradation of the carbides. Cavitation erosion tests were performed on nonimplanted and ion-implanted samples of a Co based hardface alloy (Stoody 3). Erosion of the test samples was found to initiate by debonding at the carbide-matrix interfaces and by crack propagation through the carbides. The erosion mechanisms in the alloy were altered by both N and Ti implantations. Ti implantation, in particular, appeared to significantly increase the erosion resistance of the alloy. TEM (Transmission Electron Microscopy) studies were made on nonimplanted and ion implanted foils of Stoody 3, to investigate structural changes induced by implantation. Ti implantation produced a surface layer with an amorphous matrix phase and recrystallized carbides, while N implantation greatly increased the stacking fault density in the matrix phase.

46185 (PB—86-206356/XAB) Preparation of carbon/ceramic composite materials by use of raw coke (v) - carbon/B_4C composite materials. Hagio, T.; Ogawa, I.; Yoshida, H.; Kobayashi, K. (Government Industrial Research Inst., Kyushu, Tosu, Saga (Japan)). 1986. 5p. NTIS, PC A04/MF A01).

Carbon/B_4C composites were prepared from the mixtures of raw coke and B_4C with amounts of 0-40 Vol% by pressureless sintering method at 2000 °C for 1 hour. The addition of B_4C to raw coke has improved such properties of carbon materials produced from raw coke only as bending strength, Young's modulus, electrical resistivity, thermal conductivity, and thermal shock resistance. The materials prepared from the mixture with 10 vol% of B_4C showed the lowest electrical resistivity and the highest thermal conductivity. The densification behavior of the mixture and the improvement of properties of the sintered material were considered to be closely related to the diffusion of boron into carbon.

46186 (UCID—20795) Abrasion and impact resistant coatings. Hirschfeld, T.; Haugen, G.; Steele, W. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1986. Contract W-7405-ENG-48. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014433.

Abrasion and impact resistance are a prime requirement for many materials applications. To best protect plastic of metal-based composites from abrasion and impact, a surface coating that is simultaneously very hard and highly yielding is necessary. Both these requirements can be met by a dense pattern of emergent fibers of high L/D ration, well rooted but with one and free, i.e., hair. A covering of such hair, with fibers long enough to bend over, dense enough for mutual shielding but thin enough to accommodate themselves to impacting objects, will give substantial protection against impact or particle abrasion.

46187 Effect of secondary phases on the properties of B_4C-Al composites. Sarikaya, M.; Pysik, A.J.; Ilsay, I.A.; Snowden, W.E. (Univ. of Washington, Seattle, WA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Various secondary phases form during the processing of B_4C-Al composites depending on the processing variables. The type and distribution of these phases are indicated by the reactions which take place during the densification process. Microstructures of the samples prepared under different processing conditions are investigated and correlated with the mechanical properties.

46188 Processing and microstructural characterization of boron carbide/titanium composites. Halverson, D.C.; Munir, Z.A. (Lawrence Livermore National Lab., Livermore, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

Preliminary results on the capillarity-thermodynamic behavior of boron-carbide-titanium cermets are presented using contact angle data obtained from sessile drop experiments of liquid titanium on boron carbide substrates. Wetting behavior is compared to other reactive metals on boron carbide. Examination of the interfacial phases that form and their expected role on cermet mechanical properties is also discussed.

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 45613

46189 (BNL—38242) Conductivity of polybenzimidazole in steam. Salzano, F.J. (Brookhaven National Lab., Upton, NY (USA)). Jun 1985. Contract AC02-76CH00016. 66p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014762.

Various samples of polybenzimidazole (PBI) sheet supplied by Celanese were received. They were designated as SFD-134, SFD-135, and SFD-136 and were as follows: an unmodified form, a material treated with 20% H_3PO_4, and a sulfonated form of PBI, respectively. The alternating current (ac) conductivity at 1000 cycles/sec of sheet materials (≈0.002 inches thick) was measured at temperatures up to 275°C in high pressure steam environments to ≈100 psig. Data obtained showed that these materials generally exhibited low but variable resistance when in equilibrium with liquid water, i.e., saturated conditions, and the resistance decreased with increasing temperature with a small temperature dependence corresponding to 2 to 3 kcal/g mole. At fixed steam pressures, above saturation, the cell resistance increased with increasing temperature with a steep temperature dependence corresponding to -70 to -80 kcal/g mole, in contrast to the data obtained at saturated condition at lower temperatures. These results suggest that the PBI exhibits a

form of ion conduction that is dependent on the presence of water. Subsequent ac conductivity measurements at room temperature on a larger variety of wet and dry PBI samples showed a similar large change in resistance between wet and dry conditions, with wet samples exhibiting significantly lower resistances. Furthermore, different preparations and various chemical treatments were shown to affect the resistance of wet PBI materials at room temperature. Detailed data, along with a description of the experimental technique, are presented and discussed.

46190 **(N—86-25284) Thermal desorption study of physical forces at the PTFE surface.** Wheeler, D.R.; Pepper, S.V. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1985. 15p. (NASA-TM—87090; E—2680; CONF-8506305—1). NTIS, PC A02/MF A01.

From International conference on surface and colloid chemistry; Potsdam, NY, USA (24 Jun 1985).

Thermal desorption spectroscopy (TDS) of the polytetrafluoroethylene (PTFE) surface was successfully employed to study the possibile role of physical forces in the enhancement of metal-PTFE adhesion by radiation. The thermal desorption spectra were analyzed without assumptions to yield the activation energy for desorption over a range of xenon coverage from less than 0.1 monolayer to more than 100 monolayers. For multilayer coverage, the desorption is zero-order with an activation energy equal to the sublimation energy of xenon. For submonolayer coverages, the order for desorption from the unirradiated PTFE surface is 0.73 and the activation energy for desorption is between 3.32 and 3.36 kcal/mol; less than the xenon sublimation energy. The effect of irradiation is to increase the activation energy for desorption to as high as 4 kcal/mol at low coverage.

46191 **(ORNL/Sub—84-9009/2) Aging of polyurethane foams, the influence of gas diffusion on thermal conductivity.** Ostrogorsky, A.G.; Glicksman, L.R. (Massachusetts Inst. of Tech., Cambridge (USA)). Aug 1986. Contract AC05-84OR21400. 111p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014339.

it was shown that gas diffusion in closed-cell foams is driven by partial pressure only and not by temperature gradient. The value of the foam effective thermal conductivity can be predicted rapidly and accurately by the developed ECVA code, when the diffusion coefficients of N_2, O_2, CO_2 and fluorocarbon 11 are known. The code can predict the aging rate in different thermal environments. The effective diffusion coefficient can be obtained with sufficient accuracy from the analytical or electrical model, or can be measured directly by the rapid steady state technique. It was found that porous layers exists at the foam/facing interface and inside of the foam panels. By eliminating these layers, the aging performance of the foam can be substantially improved.

46192 **Quantum Monte Carlo studies of electron—electron interaction effects in conducting polymers.** Campbell, D.K.; DeGrand, T.A.; Mazumdar, S. (Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Statistical Physics;* **43**: No. 3, 803-814(Jun 1986).

We discuss recent studies, using the quantum ensemble projector Monte Carlo (EPMC) method, of theoretical models of conducting polymers. Our focus is on the consequences of incorporating direct electron—electron interactions into the "standard" electron—phonon interaction models. Among the observables we examine one energetics of purely dimerized ground states, single solitons, soliton pairs, averaged spin and charge distributions, and local correlation functions.

3606 Other Materials

REFER ALSO TO CITATION(S) 45774, 45969, 45969, 45970, 45978, 46053, 46403, 46409, 46763, 46804, 47015, 47018

46193 **(CONF-860602—5) Analysis of the spectrum of Dy^{3+}:LaF_3 assuming a C/sub2v/ site summetry.** Goodman, G.L.; Carnall, W.T.; Rana, R.S.; Vandevelde, P.; Fluyt, L.; Goerller-Walrand, C. (Argonne National Lab., IL (USA). Chemistry Div.; College of the Holy Cross, Worcester, MA (USA). Dept. of Physics; Louvain Univ., Heverlee (Belgium). Dept. of Chemistry). Jun 1986. Contract W-31109-ENG-38. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014568.

From 17. rare earth research conference; Hamilton, Ontario, Canada (8 Jun 1986).

Previous successful analyses of the observed crystal-field structure in Tm^{3+}:LaF_3 and Ho^{3+}:LaF_3 in an approximate C/sub 2v/ site symmetry have depended upon a crystal-field model derived in an analysis of the spectrum of Er^{3+}:LaF_3. The present investigation compares the predictions of this same model to the observed crystal-field structure in Dy^{3+}:LaF_3. The energy parameters resulting from a least-square fit of the corresponding spectral assignments are reported. To help clarify the physical situation, some comparisions are offered between C/sub 2v/ and D/sub 3h/ crystal-field models for these Ln^{3+}:LaF_3 systems. 7 refs., 3 figs., 2 tabs.

46194 **(CONF-860608—5) Manipulation of displacive phase transformations.** Nevitt, M.V.; Chan, S.K.; Aldred, A.T. (Argonne National Lab., IL (USA). Materials Science and Technology Div.). Apr 1986. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014490.

From World congress on high tech ceramics: electronic, engineering, nuclear, biomedical research and applications in focus; Milan, Italy (23 Jun 1986).

The effect of ion substitutions on displacive higher-order phase transformations in ABO_4 compounds is discussed with respect to the LaNb/sub 1-x/V/sub x/O_4 and BiV/sub 1-x/Nb/sub x/O_4 systems. Although both types of substitution suppress the paraelastic to ferroelastic transformation temperature, their effects on lattice dimensions are of opposite signs. Two alternative explanations are put forward for the suppression of the transformation. One involves the changing coordination around the BO_4 tetrahedra when B is V^{5+} or Nb^{5+}. The second involves application of the ideas of percolation theory, and a plausible estimate can be made of the critical composition at which the monoclinic phase becomes unstable.

46195 **(CONF-860608—6) Effect of microstructure and surface characteristics on phase stability.** Chan, S.K.; Aldred, A.T.; Nevitt, M.V. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014491.

From World congress on high tech ceramics: electronic, engineering, nuclear, biomedical research and applications in focus; Milan, Italy (23 Jun 1986).

A theory is put forth according to which a category of ceramic materials that are susceptible to shear transformations of a continucus kind may be stabilized over a significant subcritical temperature range. The temperature range ΔT/sub c/ is a function of the grain size and the surface characteristics. Application of the theory is made to ceramic oxides of the type LaNb/sub 1-x/V/sub x/O_4 that undergo tetragonal/monoclinic shear transformations. Comparison with experiment indicates that a temperature range of stabilization ΔT/sub c/ $\sim$ 200°C is consistent with the theoretical model.

46196 (CONF-8605146—8) $(TMTSF)_2PF_6$: evidence for a unified phase diagram. Kwak, J.F.; Schirber, J.E.; Chaikin, P.M.; Williams, J.M. (Sandia National Labs., Albuquerque, NM (USA); Pennsylvania Univ., Philadelphia (USA). Dept. of Physics; Exxon Research and Engineering Co., Annandale, NJ (USA); Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014588.

From 15. Yamada conference on physics and chemistry of quasi one-dimensional conductors; Lake Kawaguchi, Japan (26 May 1986).

Magnetotransport data on $(TMTSF)_2PF_6$ under pressure is reported which links the ambient-pressure SDW and high-pressure field-induced states. Moreover, the transitions to both states fit the same simple semi-empirical formula using the same parameter values. The sequence encountered with increasing field - metal, semimetal, then semiconductor - is consistent with a scheme proposed by Yamaji. 6 refs., 2 figs.

46197 (DOE/ER/45151—2) Physical and chemical properties of graphite intercalation compounds. Progress report, August 1, 1985-October 31, 1986. Eklund, P.C. (Kentucky Univ., Lexington (USA). Dept. of Physics and Astronomy). 20 Jul 1986. Contract FG05-84ER45151. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014684.

Research on the following is summarized: c-axis electrical properties of acceptor-type graphite intercalation compounds (GICS), resonant Raman scattering in metals, charge transfer and the electrical and lattice dynamical properties of GICS, and hydrogen chemisorption and physisorption in alkali metal GICS. (DLC)

46198 (N—86-25473) Sputtered cadmium oxide as a surface pretreatment for graphite solid lubricant films. Fusaro, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 32p. (NASA-TM—87300; E—3011; CONF-861015—2). NTIS, PC A03/MF A01.

From Joint conference of the American Society of Lubrication Engineers and the American Society of Mechanical Engineers; Pittsburgh, PA, USA (19 Oct 1986).

Sputtered films of cadmium oxide were applied to sand blasted AISI 440C HT stainless steel disks as a surface pretreatment for the application of rubbed graphite films. Mixtures of cadmium oxide and graphite were applied to the nonpretreated sandblasted metal and evaluated. The results were compared to graphite films applied to other commercially available surface pretreatments. It is found that sputtered CdO pretreated surfaces increase the endurance lives of the graphite films and decrease the counterface steady state wear rate of the pins almost an order of magnitude compared to commercially available pretreatments. The CdO additions in general improved the tribological properties of graphite. The greatest benefit occurred when it was applied to the substrate rather than mixing it with the graphite and that sputtered films of CdO perform much better than rubbed CdO films.

46199 (SAND—86-0824C) Catalyst preparation via hydrous metal oxide ion-exchangers. Stephens, H.P.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 21p. (CONF-8609108—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012278.

From International symposium on the scientific bases for the preparation of heterogeneous catalysts; Louvain-La-Neuve, Belgium (1 Sep 1986).

Preparation of catalysts via a synthesis route which involves the use of inorganic ion-exchangers based on alkoxide derived Ti, Zr, Nb, and Ta hydrous oxides is described. These materials exhibit several unique properties, including Bronsted acidities that may be varied over many orders of magnitude by a facile ion-exchange process and the capacity to uniformally disperse any metal or mixtures of metals. The activities of Pd-exchanged hydrous titanium oxide catalysts, evaluated for the hydrogenation of pyrene, were found to dramatically increase with Bronsted acidity. The most active of the catalysts was an order of magnitude more active than gamma alumina-supported Pd catalysts prepared by incipient wetness techniques. A mechanism is proposed to account for the high activity of the acidified catalysts.

46200 (SAND—86-1601C) Use of DSC to determine the structure of sol-gel derived glasses. Roth, E.P.; Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 7p. (CONF-8609122—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013353.

From 15. North American Thermal Analysis Society conference; Cincinnati, OH, USA (21 Sep 1986).

Differential scanning calorimetry (DSC) has been used to measure quantitative enthalpic changes which accompany gel densification in sol-gel derived glasses. These results, along with measurements of shrinkage and weight loss, were used to identify densification mechanisms. Gel densification is a complex, multistage process consisting of: (1) capillary contraction; (2) condensation polymerization; (3) structural relaxation; and (4) viscous sintering. Gel composition and preparation procedures were varied in order to more clearly observe and quantify some of these densification mechanisms. In particular, metastable defect species were identified by the use of quantitative DSC and Raman spectroscopy.

46201 (SAND—86-1701C) Sol-gel derived thin films: critical issues. Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 26p. (CONF-8609120—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014149.

From NATO workshop on the design, activation and transformation of organometallics into common and exotic materials; Cape d'Agde, France (1 Sep 1986).

The critical physical and chemical issues concerning sol-gel-derived thin films are reviewed. The fundamental physical issues which are currently poorly understood are concentration-induced aggregation and gelation and the physics of drying porous media. These phenomena depend in turn on chemical issues such as the relative rates of condensation and evaporation during film deposition. Preliminary experiments demonstrate the tailoring of thin film structure by controlling precursor polymer structure prior to deposition and the relative rates of condensation and evaporation during deposition.

46202 Contactless measurement of bulk free-carrier lifetime in cast polycrystalline silicon ingots. Johnson, S.M.; Johnson, L.G. (Solarex Corporation, 1335 Piccard Drive, Rockville, Maryland 20850). *Journal of Applied Physics;* **60**: No. 6, 2008-2015(15 Sep 1986).

The spatial dependence of the bulk free-carrier lifetime in cast polycrystalline silicon ingots was determined from contactless measurements of optically modulated free-carrier infrared absorption. Using a cw Nd: yttrium aluminum garnet (Nd:YAG) laser (λ = 1.319 μm) for a probe and a novel pulsed tunable infrared dye laser (λ = 1.10—1.13 μm), with photon energies near the Si band gap, for a pump, the free-carrier lifetime was determined from transient absorption measurements to a maximum depth of 3.0 cm from the surface of polycrystalline silicon ingots. Unmodulated infrared probe transmission measurements were used to monitor relative changes in the bulk precipitate density in ingots due to infrared scattering by the precipitates. Free-carrier lifetime profiles measured along the growth axis of polycrystalline silicon ingots had the same qualitative features as the minority carrier lifetime profile measured from n-italic$^+$ p-italic junction solar cells fabricated on the wafered ingots. Differences between the ingot-measured free-carrier lifetimes and the minority carrier lifetime, apparently due to high injection and possibly carrier trapping effects, are discussed.

46203 Single crystal, epitaxial multilayers of AlAs, GaAs, and Al/sub x-italic/Ga/sub 1-//sub x-italic/As for use as optical interferometric elements. Gourley, P.L.; Drummond, T.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **49**: No. 9, 489-491(1 Sep 1986). Contract AC04-76DP00789.

We propose using single crystal multilayers of AlAs, GaAs, and Al/sub x-italic/Ga/sub 1-//sub x-italic/As for use as several different kinds of optical interference elements which include high reflectors, transmission filters, and Fabry—Perot cavities. We have grown many of these structures by molecular beam epitaxy and measured their optical characteristics. We find the characteristics of

these structures to be very useful for a number of applications for integrated optical devices which we also propose.

46204 Response to "Comment on 'Galvanomagnetic luminescence of indium antimonide' " [Appl. Phys. Lett. 49, 537 (1986)]. Berdahl, P.; Shaffer, L. (Applied Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* 49: No. 9, 537-538(1 Sep 1986). Contract AC03-76SF00098.

The authors respond to the comments of Morimoto and Chiba by pointing out that the authors theory and unpublished data on the galvanomagnetic luminescence in indium antimonide supports the conclusion that the emission intensity is independent of the thickness for values of the thickness (d) much larger than the effective diffusion length L (3 microns). This contradicts the conclusion of Morimoto and Chiba who determined that the emission varied as d^{-3}.(AIP)

46205 Effect of static charge on the infrared spectrum of amorphous silicon. Fong, C.Y.; Nichols, C.S.; Guttman, L.; Klein, B.M. (Department of Physics, University of California, Davis, California 95616). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2402-2406(15 Aug 1986).

Using first-principles electronic and lattice-dynamics calculations, we calculate the far-infrared spectrum of amorphous silicon including the static polarization due to disorder. The peak positions as well as the magnitude of the absorption coefficient in the region of the bending modes agree with experiment. A random distribution of static charges leads to an infrared spectrum which merely reflects the vibrational density of states.

46206 Time-resolved reflectivity measurements on silicon and germanium using a pulsed excimer KrF laser heating beam. Jellison G.E. Jr.; Lowndes, D.H.; Mashburn, D.N.; Wood, R.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2407-2415(15 Aug 1986). Contract AC05-84OR21400.

Time-resolved reflectivity measurements on silicon and germanium have been made during pulsed KrF excimer laser irradiation (248 nm). The reflectivity was measured simultaneously with probe-laser wavelengths of 632.8 and 1152 nm, and the energy density of each laser pulse was recorded. From these measurements, we were able to determine the reflectivity of the hot solid just before the onset of melting, the reflectivity of the melt, the melt duration, and the time of the onset of melting. Melting-model calculations were also performed, with the reflectivity of solid and liquid Si and Ge treated as parameters for fitting the experimental values of the melt duration and the time of the onset of melting. The resulting parameter values are in agreement with those obtained from self-reflectivity measurements. Near the melting threshold, it was observed that the melt duration was never less than 20 ns for Si and 25 ns for Ge, while the maximum reflectivity increased from its value for the hot solid to that for the liquid over a finite energy range. These results, together with a reinterpretation of time-resolved ellipsometry measurements, indicate that, during the melt-in process, the near-surface region does not melt homogeneously, but rather consists of a mixture of solid and liquid phases.

46207 Photoconductivity and light-induced change in a-italic-Si:H. McMahon, T.J.; Xi, J.P. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2475-2481(15 Aug 1986). Contract AC02-83CH10093.

Capture-rate constants for the trapping of free carriers into different gap-state species are determined by calculating dc photoconductivity at intermediate generation rates versus the inverse temperature and fitting to data measured on undoped a-italic-Si:H in the as-grown and light-soaked states. In the as-grown state, recombination is dominated by high-capture-rate centers near the Fermi level (dangling bonds) at and above 300 K. To explain the second peak and rapid decrease in photoconductivity at lower temperatures, an energy-dependent capture rate must be invoked on the smaller-cross-section band-tail states, indicating a multiphonon energy-loss process for the trapping of free charge. After 90 h of exposure to 100 mW/cm^2 of light, the decrease found in photoconductivity is explained only by increases in both dangling-bond recombination at and above room temperature a-italicn-italicd-italic tail-state recombination at lower temperatures. The increased recombination at lower temperatures after light soaking is attributed to additional donor states located 0.23 eV above the valence-band edge.

46208 Initial stage of thermal oxidation of the Si(111)-(7 x 7) surface. Tabe, M.; Chiang, T.T.; Lindau, I.; Spicer, W.E. (Atsugi Electrical Communication Laboratories, Nippon Telegraph and Telephone Corporation, 3-1, Morinosato Wakamiya, Atsugi-shi, Kanagawa, 243-01 Japan). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2706-2717(15 Aug 1986).

We report a systematic study of the early oxidation process in a wide temperature range (20—700XdeC) for the Si(111)-(7 x 7) annealed surface. Oxygen uptake data obtained by Auger-electron spectroscopy indicate that the surface oxygen uptake increases and then gradually saturates with O_2 exposure at 20XdeC. At intermediate temperatures, there is no saturation and the oxygen uptake rate is enhanced. At 700XdeC, the uptake rate is enhanced in the high-exposure (or high-O_2-pressure) region, but is significantly reduced in the low-exposure region, presumably because of oxygen desorption as volatile SiO.

46209 Lattice dynamics and phonon line shapes in /sup 36/Ar at high temperatures. Eckert, J.; Youngblood, R.W. (Physics Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* 34: No. 4, 2770-2776(15 Aug 1986).

The inelastic neutron scattering technique has been used to measure phonon frequencies and phonon line shapes in /sup 36/Ar at temperatures of 81 K [lattice constant a-italic = 5.465(2) A-circle] and 55 K [a-italic = 5.440(2) A-circle] primarily along the [100] and [110] directions. The 81-K data combined with earlier results for small wave vector by Fujii e-italict-italic a-italicl-italic. were fitted to a force-constant model. Detailed comparisons are made of the observed phonon line shapes with those computed from the self-consistent harmonic approximation with added cubic anharmonicity (Glyde and co-workers) and molecular-dynamics simulations (Hansen and Klein). The agreement at high temperatures though still quite satisfactory, was found to be not as good as at low temperatures.

46210 Time-resolved picosecond optical measurements of laser-excited graphite. Malvezzi, A.M.; Bloembergen, N.; Huang, C.Y. (Gordon McKay Laboratory, Harvard University, Cambridge, Massachusetts 02138). *Physical Review Letters;* 57: No. 1, 146-149(7 Jul 1986).

A phase transformation in graphite irradiated by visible picosecond laser pulses is observed above a well-defined pump threshold. Time-resolved reflectivity measurements at different wavelengths indicate that the high-temperature phase is not metallic. At low irradiation levels, a fast decaying plasma component is observed.

46211 Ordering and decomposition in semiconductor alloys. Martins, J.L.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Materials Research;* 1: No. 4, 523-526(Jul 1986).

The stability of ordered semiconductor alloys has been studied, using total energy pseudopotential calculations. The ordered alloys are found to be stabilized with respect to disordered alloys via reduction of the internal strain and by chemical interactions. The Si—C and Si—Ge systems are used as illustrations, finding that ordered Si/sub x-italic/Ge_1/sub -//sub x-italic/ should be a metastable alloy, in agreement with experimental observations.

46212 On the kinetics of thermal donor formation in silicon. Borenstein, J.T.; Peak, D.; Corbett, J.W. (Physics Department, SUNY at Albany, Albany, New York 12222). *Journal of Materials Research;* 1: No. 4, 527-536(Jul 1986).

A model for the kinetic growth of oxygen-related thermal donors in Czochralski silicon at about 450 °C is presented. The

model, which is based on the work of Suezawa and Sumino, derives forward reaction rates for the electrically active species by comparing analytic expressions for the early-time annealing kinetics with the infrared electronic absorption data. The analytic expressions, which are independent of the chemical structure of each species, result from three assumptions: (1) the donor defects beyond the first donor species (TD-1) are chemically stable at the donor formation temperature, (2) the reactions for the TD-1 and those electrically inactive clusters smaller than TD-1 are in equilibrium, and (3) the oxygen interstitial concentration remains constant for short annealing times. The parametrized values of the rate constants indicate that the forward rates of reaction vary widely between species, with a sharp peak at the reaction which takes the first electrically active species to the second. If the rate constants are taken to be of the form K-italic = 4πR-italicD-italic, where R-italic is the capture radius for the given forward reaction and D-italic represents the effective diffusion coefficient, then the variation between reaction constants may be associated with differences in capture radii between species, with the diffusion coefficient assumed to be the value determined by Stavola e-italict-italic a-italicl-italic. [Appl. Phys. Lett. 42, 73 (1983)] for "as-provided" material, which has an activation energy of 1.95 eV. The model is successfully applied to the two available sets of infrared absorption data (the Oeder—Wagner and Suezawa—Sumino data) when differences in the annealing temperatures and initial oxygen concentrations are taken into account.

46213 **Energy-dispersive X-ray diffraction study of mean-square atom displacements in highly oriented pyrolytic graphite.** Metzger, T.H. (Brookhaven National Lab., Upton, NY, USA). *Journal of Applied Crystallography;* **19**: No. 3, 200-201(1 Jun 1986). Contract AC02-76CH00016.

The measurement of the mean-square thermal displacement $<u^2>$ of carbon atoms in highly oriented pyrolytic graphite (HOPG) in the hexagonal c direction is reported. Energy-dispersive X-ray diffraction (EDXD) has been used to study the integrated intensity of all Bragg reflections 004 through 0,0,14 as a function of temperature. It is demonstrated that the correction of the Bragg intensities due to thermal diffuse scattering contributions is very important for HOPG, when EDXD is used. The Debye temperature THETAsub(D) = 554(30) K is obtained.

46214 **Surface areas by positron annihilation spectroscopy.** Dale, J.M.; Rosseel, T.M.; Hulett, L.D.; Venkateswaran, K.; Jean, Y.C.; Fuller, E.L. (Oak Ridge National Lab., TN). pp 225-230 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Positron annihilation spectroscopy (PAS) is a technique for measuring the length of time that a positron exists after being injected into a specific material. Lifetime measurements have been used for studying defects in metals. These imperfections affect the localized electron densities which in turn influence the lifetime of the positron before annihilation occurs. Electron density differences are also associated with surfaces. This paper describes the PAS technique and shows a correlation between positron annihilation intensities and surface areas of some fumed amorphous silicas.

46215 **Steel bonded dense silicon nitride compositions and method for their fabrication.** Landingham, R.L.; Shell, T.E. (to Dept. of Energy). US Patent Application 6-736,024. 20 May 1985. 27p. Contract W-7405-ENG-48. DE86013718 NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013718.

A two-stage bonding technique for bonding high density silicon nitride and other ceramic materials to stainless steel and other hard metals, and multilayered ceramic-metal composites prepared by the technique are disclosed. The technique involves initially slurry coating a surface of the ceramic material at about 1500°C in a vacuum with a refractory material and the stainless steel is then pressure bonded to the metallic coated surface by brazing it with nickel-copper-silver or nickel-copper-manganese alloys at a temperature in the range of about 850° to 950°C in a vacuum. The two-stage bonding technique minimizes the temperature-expansion mismatch between the dissimilar materials.

46216 **Densification of glass compacts containing a second phase.** Rahaman, M.N.; DeJonghe, L.C. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The densification behavior of glass powder compacts containing different volume fractions of a dense, hard, second phase was studied. The results are in good agreement with the predictions of a rule of mixtures. The results are compared with those for other ceramic systems and with the predictions of recent theories.

46217 **Characterization of crystallographic phases in the Al_2O_3-AlN system by convergent beam electron diffraction.** Krishnan, K.M.; Thomas, G. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The structure of two crystallographic phases in the AL_2O_3-AlN system have been determined by CBED. A cubic spinel (Fd3m) phase at a composition of Al_2O_3 - 35mol% AlN and a new long period polytypoid structure (32H) at a composition of AL_2O_3 - 95mol% AlN have been identified. Details of the application of the technique of CBED and the results are presented.

46218 **Convergent beam electron diffraction studies on lead zirconate titanate.** Dass, M.L.A.; Goo, E.; Bielicki, T.; Thomas, G. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

At the morphotropic phase boundary the lattice parameters of the tetragonal and rhombohedral phases are very close to each other and the deviations from cubic structures are very small. Conventional electron diffraction is not adequate to identify the phases present at the morphotropic phase boundary where it is believed that both the tetragonal and the rhombohedral phases coexist. Convergent beam electron diffraction is used to study the $Pb(Zr,Ti)O_3$ solid solution both at the single phase regions and the morphotrophic phase boundary region to identify the phases at the boundary.

46219 **Microstructure and microanalysis of spinel and pyrochlore phases in ZnO varistors.** Goo, E.; Thomas, G. (Lawrence Berkeley Lab., Berkeley, CA). pp vp of Abstracts of the 38th annual Pacific Coast regional meeting of the American Ceramic Society. Columbus, OH; American Ceramic Society (1985). (CONF-851011—).

From 4. symposium on separation science and technology for energy applications; Knoxville, TN, USA (20 Oct 1985).

The location and chemical composition for the spinel and pyrochlore phases in ZnO varistors has been determined by transmission electron microscopy. The composition of the varistors is 94 mole% ZnO, 2 mole% Sb_2O_3, 1 mole% $MnCO_3$, 1 mole% CoO and 1 mole% Bi_2O_3 which was sintered at 1250°C. The spinel phase exists as 1-5 μm size grains and as 0.1 - 0.5 μm particles within ZnO grains. The pyrochlore phase is only present as 500 A particles within ZnO spinel grains. The effect of CoO and $MnCO_3$ additions on the microstructure is examined.

46220 **Structure of di(3,3',4,4'-tetramethyl-2,2',5,5'-tetraselenafulvalenium) pentafluorosilicate, $(C_{10}H_{12}Se_4)_2SiF_5$ at 293 and 125 K.** Eriks, K.; Beno, M.A.; Bechgaard, K.; Williams, J.M. (Argonne National Lab., IL). *Acta Crystallographica, Section C: Crystal Structure Communications;* **C40**: 1715-1717(1984). Contract W-31-109-ENG-38.

The crystal structure of the electrically conducting monovalent anion salt di(3,3',4,4'-tetramethyl-2,2',5,5'-tetraselenafulvalenium) pentafluorosilicate, or $(TMTSF)_2SiF_5$ was determined, using

X-ray reflections. No structural phase transition is observed between room temperature and 125 K. The structure is isomorphous with other highly electrically conducting $(TMTSF)_2X$ (X = monovalent anion) salts. The pentafluorosilicate ion is disordered at both temperatures. This report represents the first structural study of a 2:1 TMTSF salt containing an anion with a geometry intermediate between octahedral and tetrahedral. The structure is considered to contain positively charged TMTSF sheets that are interconnected through short Se-Se contacts, with the anions located between the sheets. The above features, plus hydrogen bonding between methyl groups and fluorine atoms, are likely responsible for the unusual electrical properties associated with anion-ordering transitions in this class of compounds.

46221 **Novel structure modulation in the first ambient-pressure sulfur-based organic superconductor $(BEDT\text{-}TTF)_2I_3$.** Leung, P.C.W.; Emge, T.J.; Beno, M.A.; Wang, H.H.; Williams, J.M.; Petricek, V.; Coppens, P. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **106**: No. 24, 7644-7646(1984). Contract W-31-109-ENG-38.

The compound bis(ethylenedithio)tetrathiofulvalene, or ET, is the first ambient-pressure sulfur-containing organic superconductor. It is further unique in having a displacively modulated structure below 200 K, which persists to at least 11 K. Important features of the room-temperature structure are the existence of ribbons of triodide anions and loose columnar stacks of ET molecules having intrastack S-S distances greater than 3.6 A, the sum of the van der Waals radii. The ET molecules are linked into infinite corrugated sheets by short interstack S-S distances less than 3.6 A and which lie approximately perpendicular to the ET molecule column-packing axis. These short interstack distances appear especially pertinent to the anisotropic (two-dimensional) electrical properties, which include a relatively high conductivity in directions parallel to the sheets. Crystal data was obtained by X-ray diffraction by use of the JANA program, which allows the description of the main and satellite intensities in a modulated structure in terms of one or more sinusoidal displacement waves with associated phases.

46222 **Synthesis of surface reactance using an artificial dielectric.** King, R.J.; Thiel, D.V.; Park, K.S. (Lawrence Livermore National Lab., CA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Antennas and Propagation;* **AP-31**: No. 3, 471-476(May 1983).

A thin artificial dielectric layer consisting of a rectangular array of closely spaced, thin conductive cylinders (pins), was constructed above a perfectly conducting ground plane. The reactance of the surface was measured at 4.8 GHz for a variety of pin heights and dielectric embedding material by measuring the height-gain profile of a transverse magnetic (TM) surface wave launched across it. Design equations using the theories of artificial dielectrics and propagation in anisotropic media are given. These can be used to predict the surface reactance providing a correction factor accounting for fringing fields at the tops of the pins is included. Using an embedding dielectric tends to reduce this fringing effect. 16 references, 1 table.

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REFER ALSO TO CITATION(S) 45592, 45597, 45626, 45674, 45675, 45738, 45774, 46158, 46219, 46313, 46316, 46549, 46631, 46634, 46647, 46732, 46733, 46734, 46734, 47005

46223 **(BNL—38365) Some uncertainties associated with preparation of standards in organic matrix.** Cholewa, M.; Hanson, A.L.; Jones, K.W.; McNally, W.P.; Fand, I. (Brookhaven National Lab., Upton, NY (USA); Institute of Nuclear Physics, Krakow (Poland); State Univ. of New York, Stony Brook (USA). Dept. of Psychiatry and Behavioral Science). 1986. Contract AC02-76CH00016. 10p. (CONF-8604229—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014173.

From 2. international symposium on biological reference materials; Neuherberg, F.R. Germany (24 Apr 1986).

Until recently no techniques which have multielement detection capability, high sensitivity and good spatial resolution in relatively thick tissue sections have existed. The use of proton induced x-ray emission /PIXE/ and synchrotron radiation induced x-ray emission /SRIXE/ using proton and x-ray microbeams changed this situation. However there are some difficulties with the existing standards for quantitatively calibrating the trace elements concentration in biological materials. For the purpose of our experiments a special technique of standard production was applied. 7 refs., 1 tab., 1 fig.

46224 **(ENEA-RT-TIB—86/5) Application of thermal and epithermal neutron activation analysis to rock and sediment samples. Advantages of matrix preseparation for rare earth element determination.** Madaro, M.; Moauro, A. (ENEA, Rome (Italy)). 1986. 10p. (CONF-8506271—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE86901526.

From 2. Hungaro-Italian symposium on spectrochemistry: natural materials and spectral analysis; Budapest, Hungary (10 Jun 1985).

Neutron activation analysis (NAA) has been applied to the determination of several trace elements in rocks and in marine sediments. Epithermal neutron activation analysis (ENAA) has been shown to be useful in the analysis of rocks, because some strong activities limiting the instrumental determination of many elements are reduced. Some USGS geological reference materials have been activated by both thermal and epithermal neutrons, evaluating the experimental advantage factors of ENAA and comparing the obtained concentrations and the detection limits for both methods. ENAA is particularly useful to determine several elements, among which some of the rare earth elements (REE), whose importance in petrogenetic studies is well known. In the case of marine sediments, the REE are considered particularly important for simulating the chemical behaviour of the actinides in the environment. For this purpose, REE have been determined after a group separation from the matrix, in order reduce the complexity of the activation gamma-ray spectra. This separation step improves detection limits for all REE, allowing the determination of some of them not easily detected without a separation, like Nd, Gd, Tb and Tm.

46225 **(EUR—10294-EN) Certification of the elemental composition of BCR reference material No. 183 containing carbon, hydrogen, fluorine, sulphur, phosphorus and copper.** Belliardo, J.J.; Colinet, E.; Griepink, B.; Le Duigou, Y. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 40p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information. Applied metrology.

A compound of empirical composition $C_{37}H_{30}CuF_3O_3P_2S$ [bis(triphenylphosphine)-copper-trifluoromethanesulphonate] has been specially synthesized and purified, and the elemental composition determined in an interlaboratory exercise involving eleven laboratories of EC member countries. A variety of independent analytical methods were applied. The results of the measurements have permitted the contents of the following elements to be certified: carbon, hydrogen, fluorine, sulphur, phosphorus, copper. This report describes the certification procedure and analysis of the results.

46226 **(EUR—10380-EN) Certification of lead and cadmium in three lyophilized blood materials. CRM No. 194, 195, 196.** Yeoman, W.B.; Colinet, E.; Griepink, B. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 57p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information.

The report describes the work for certification of lead and cadmium in three lyophilized samples of bovine blood materials. Homogeneity and stability tests were carried out and are presented in the report. The concentrations of lead and cadmium in each

sample of the reconstituted blood are certified. A variety of well established methods were used for certification of the materials.

46227 (INIS-mf—10174, pp IV/12) **High sensitive activation analysis using an underground laboratory for gamma-spectroscopy.** Helbig, W.; Niese, S. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46228 (INIS-mf—10174, pp XI/59) **Determination of carbon-14 in Bulgarian wines.** Kostadinov, K.N.; Yanev, Y.L. (Sofia Univ., Bulgaria. Khimicheski Fakultet). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46229 (INIS-mf—10174, pp XII/63) **Attempt to determine environmental ^{36}Cl in groundwater by liquid scintillation counting.** Florkowski, T. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46230 (INIS-mf—10174, pp XII/64) **Determination of $^{238}U/^{234}U$ ratio by means of liquid scintillation technique.** Tomza, I.; Pluta, I. (Central Mining Institute, Katowice, Poland). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46231 (INIS-mf—10174, pp XIII/78) **Neutron activation method of U content determination by ^{133}Xe.** Fisenko, A.V.; Kashkarova, V.G.; Lavrukhina, A.K. (AN SSSR, Moscow. Inst. Geokhimii i Analiticheskoj Khimii). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46232 (INIS-mf—10174, pp XIII/79) **Thin layer surface activation by charged particles used for wear investigations.** Kosinova, M.; Tendera, P. (Statni Vyzkumny Ustav Materialu, Prague, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46233 (INIS-mf—10174, pp XIII/84) **Gamma-ray spectrometric measurement of natural radionuclides distribution in rocks.** Benovic, D.; Chrapan, J.; Katlovsky, V. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta; Slovenska Akademia Vied, Bratislava, Czechoslovakia. Geologicky Ustav). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46234 (INIS-mf—10174, pp XV/90) **Measurement of all radium isotopes at environmental levels on a single electrodeposited source.** Short, S. (Australian Atomic Energy Commission, Sydney). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46235 (INIS-mf—10174, pp XVII/100) **Measurement of plutonium-241 in the terrestrial environment.** Wilkins, B.T.; Major, R.O. (National Radiological Protection Board, Chilton, UK). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46236 (INIS-mf—10174, pp XVII/101) **Gamma-spectrometric investigation of low activities of technogenic radionuclides in the surface air layer.** Veleva, B.; Kolarova, M.; Teneva, M.; Dimchev, T. (Bylgarska Akademiya na Naukite, Sofia; Vissh Minno-Geolozhki Inst., Sofia, Bulgaria). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46237 (INIS-mf—10174, pp II/4) **^{10}Be in natural archives: information on past solar modulation and climate.** Beer, J. (Bern Univ., Switzerland. Physikalisches Inst.). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46238 (MINTEK-M—209) **Surface-chemical and mineralogical properties relevant to the flotation of talc and other layer silicates.** Steenberg, E.; Harris, P.J. (Council for Mineral Technology, Randburg (South Africa)). 5 Jul 1985. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703153.

Certain physicochemical and mineralogical properties of different talc and pyrophylite samples were measured to show whether differences in floatability could be related to these properties. An indication of the expected hydrophobic nature of the samples was obtained by X-ray-diffraction measurements. The various samples were characterized by measurement of their zeta potentials, contact angles, suspension stability, and flotation behaviour in small-scale flotation cells. All the talc samples proved to be highly floatable and therefore only small differences in recoveries were observed. However, there was some indication that the suspension stability was related to the X-ray-diffraction measurements of the hydrophobic nature of the samples. No trends were observable from the zeta potentials and contact angles measured.

46239 (MLM—3362) **Assay of ceramic headers for sodium by neutron activation.** Anderson, M.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 30 Jun 1986. Contract AC04-76DP00053. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014266.

A procedure was developed for assaying alumina ceramic headers for sodium by neutron activation using the reaction $^{23}Na(n,\gamma)^{24}Na$. The neutron source is a californium-uranium subcritical assembly called the CFX. Major interference results from the fast neutron reaction $^{27}Al(n,\alpha)^{24}Na$. The assay and calibration procedures are described as well as the thermal and fast neutron gradients at the CFX flux trap. 3 refs., 8 figs.

46240 (NAC-AR—85-01, pp 209-211) **Nuclear analysis: applications in industry and agriculture.** 1985. NTIS (US Sales Only), PC A13/MF A01. File Number DE86702790.

In Annual report June 1985.

The importance of trace elements in assisting or adversely affecting plant growth is well-established. Nuclear analytical techniques can again be effectively applied to measure trace element composition and the relative effect of environmental conditions.

46241 (ORNL/TM—9950) **Turbulent dispersion results from gel-sphere processes and application to centrifugal contactors.** Haas, P.A. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014395.

Three different devices using controlled velocities of organic liquids were applied to disperse aqueous solutions as drops. One

consisted of simple tubes of small diameters. A second contained motionless mixer units inside large tubes. The third employed couette flow of the organic liquid between a cylindrical rotor and a stationary cylinder. These devices were applied to gel-sphere processes in which the liquid drops are converted into solid gel spheres of hydrated metal oxides. The gel-sphere products are good, strong spheres and allow good measurement of the sphere and the drop-size distributions. The drop diameters must be controlled and predictable to allow preparation of product spheres of the desired sizes. Empirical correlations were determined for application to the gel-sphere processes. The theory of turbulent dispersion based on eddy velocities has been developed by Kolmorogoff, Hinze, and others. Davies reviewed this theory and the agreement of theory with four types of dispersion devices for energy dissipation rates of 6 to 400,000 W/g. The gel-sphere results for drop-size distribution are for energy dissipation rates of 10^{-3} to 1.5 W/g. Those combined results support the theory of turbulence as the dispersion mechanism over a range of 10^9 for the rate of energy dissipation. The turbulent dispersion with Couette flow is the mechanism for mixing in an advanced design of centrifugal contactors for solvent extraction. The theory of turbulence is applied to predict drop sizes and mixing power for centrifugal contactors as developed at Oak Ridge National Laboratory (ORNL). 14 refs., 7 figs., 6 tabs.

46242 **(PB—86-205309/XAB) Improved analyzer for determining helium-4 in parts-per-billion range. Report of Investigations/1986.** Seitz, C.A.; Holland, P.W. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1986. 14p. (BM-RI—9010). NTIS, PC A02/MF A01.

The Bureu of Mines has modified its parts-per-billion helium-4 analyzer to improve the analytical capabilities of the instrument. The modifications resulted in the following improvements: (1) the analytical precision of the instrument for 10 consecutive analyses was improved to + or - ppb at the 5000 ppb helium-4 level, (2) the helium-4 sensitivity was increased almost tenfold, and (3) the minimum detectable limit for helium-4 was improved to 0.5 ppb. The modifications made to improve the instrument included replacing the ion-source control circuit with a direct-current solid-state design, controlling the temperature of the ion source, stabilizing and reducing the pumping rate of the vacuum system, and optimizing peak integration.

46243 (PNCT-N—831-83-01, pp 27-32) **Determination of nitrogen in PuO_2-UO_2 mixed oxide with fusion-TCD method.** Hiyama, Toshiaki; Takahashi, Toshio; Ohuchi, Yoshiro; Suzuki, Takeshi; Kaya, Akira. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki, Japan. Tokai Works). Sep 1983. NTIS (US Sales Only), PC A08/MF A01. File Number DE86730437.

In Annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. April 1982-March 1983.

Nitrogen in plutonium and uranium mixed oxide has been determined by several different methods. In the classical Dumas method, nitrogen is measured volumetrically. Other procedures are modifications of the Kjeldahl method in which nitrogen is converted to ammonia. All these methods are accompanied with the same problems in which the analysis takes usually 2 or 3 days with waste solutions generated. So far, the authors have tried to determine nitrogen in PuO_2-UO_2 mixed oxide with an improved dry process, in which an impulse furnace is used to heat the sample in a graphite crucible under a helium atmosphere. Nitrogen released from the sample was separated from other gases (i.e., a large amount of carbon monoxide, very small amount of hydrogen etc.) by a combination of original two moleculer sieve columns and pre-cut system. Separated nitrogen was then detected on the basis of thermal conductivities.

46244 **(RT/TIB—85/27) Applied research performed and in progress by using a TRIGA nuclear reactor.** Moauro, A.; Madaro, M. (ENEA, Casaccia (Italy). Dipartimento Tecnologie Intersettorialli di Base). Oct 1985. 23p. (CONF-850932—3). NTIS (US Sales Only), PC AA02. File Number DE86901559.

From Seminar on applied research and service activities for research reactor operations; Copenhagen, Denmark (9 Sep 1985).

The TRIGA reactor of ENEA Casaccia has been used in different applied research fields among which particularly applications of neutron activation analysis (NAA) are reported. The results are referred to the determination of about 30 microelements in marine suspended particulate matter and sediments. A study was also performed on the impurities of the filters used for environmental studies and an intercomparison was carried out on two sediments distributed by the Joint Research Center, Ispra, Euratom. Many applications of NAA have been performed in forensics on request of Italian Courts for determination of gunshot residues, particularly on paraffin gloves and clothes of person suspected to have handled and/or fired a gun; also the firing distance was determined in some cases. The uptake of cobalt and zinc has been studied in pot and the tolerance index was established in cooperation with the Istituto di Cerealicoltura Roma. The rare earth concentrations normalized with respect to the chondritic rocks can be utilized for petrogenetic studies and some determinations have been performed both by thermal and epithermal NAA on some rock samples. A program of utilization of the TRIGA reactor in the field of the preparation of a Ir-191m generator has been provided for applications in the pediatric angiography. For this purpose a cooperation with the Clinical Physiology Institute of National Research Council of Pisa has been established.

46245 (ZfI-Mitt—99, pp 5-37) **Contributions to the chemistry of lanthanides and transplutonium elements.** Bruchertseifer, H.; Hussonnois, M.; Krupa, J.C.; Constantinescu, M.; Constantinescu, O. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung; Institut de Physique Nucleaire, Orsay, France; Institutul de Fizica si Inginerie Nucleara, Bucharest, Romania). Dec 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86780479.

In Report of the Central Institute for Isotope and Radiation Research.

In order to find the conditions for the fast and selective chemical separation of individual nuclides from a group of transfermium elements the following experiments have been carried out: extraction of bivalent ions as kryptate complexes taking strontium as an example and the electro-chemical reduction of europium(III) and stabilization of the formed europium(II) with kryptands. The results obtained have been applied to separate bivalent ions from aqueous solutions for analysing the products of the nuclear reaction $^{249}Bk + {}^{22}Ne$. Finally, first quantitative data are presented for the hydrolysis of Md^{3+} in aqueous solution.

46246 **Photochemical effects in 205-nm, two-photon-excited fluorescence detection of atomic hydrogen in flames.** Goldsmith, J.E.M. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Optics Letters;* **11**: No. 7, 416-418(Jul 1986).

This Letter describes photochemical effects observed by using 205-nm, two-photon-excited fluorescence spectroscopy to measure the atomic-hydrogen concentration in atmospheric-pressure hydrogen—oxygen flames. We found that the 205-nm radiation photolyzed water produced in the flame, forming atomic hydrogen in concentrations higher than those naturally present in lean flames and leading to erroneous concentration measurements. UV excitation of molecular oxygen transitions near 205 nm is also discussed; such excitation, followed by rapid predissociation to produce atomic oxygen, may also affect some flame measurements.

46247 **Quenching-independent fluorescence measurements of atomic hydrogen with photoionization controlled-loss spectroscopy.** Salmon, J.T.; Laurendeau, N.M. (Flame Diagnostics Laboratory, School of Mechanical Engineering, Purdue University, West Lafayette, Indiana 47907). *Optics Letters;* **11**: No. 7, 419-421(Jul 1986).

Quenching-independent fluorescence by atomic hydrogen has been measured with photoionization controlled-loss spectroscopy (PICLS) in stoichiometric and fuel-rich premixed $H_2/O_2/N_2$ flames at a pressure of 20 Torr. These measurements are compared with conventional fluorescence measurements in the same flames. When matched in the postflame zone, the two sets of measurements diverge in the preheat zone between the burner surface and the peak of the fluorescence profiles. This divergence, caused by

changes in the local quenching rate coefficient, shows the utility of PICLS for determining the kinetics of atomic hydrogen in the preheat zone.

46248 Laser-enhanced electron-impact ionization spectroscopy. Bushaw, B.A.; Cannon, B.D.; Gerke, G.K.; Whitaker, T.J. (Pacific Northwest Laboratory, Box 999, Richland, Washington 99352). *Optics Letters;* **11**: No. 7, 422-424(Jul 1986). Contract AC06-76RL01830.

Sequential photon-excitation, electron-impact ionization with subsequent mass analysis has been applied to a barium atomic beam. High-resolution, Doppler-free laser excitation produces the 6s-italic6p-italic ^{1}P-italic$_1$ excited state, which is then ionized by electron bombardment. The excited state is selectively ionized when bombardment energies are between the excited- and ground-state ionization thresholds. Mass discrimination has permitted the recording of individual optical spectra for all the stable isotopes, including the 0.1% abundant /sup 130/Ba and /sup 132/Ba, in a sample with natural isotopic abundances.

46249 Hazardous waste analysis by direct-linked fused silica capillary column gas chromatography/fourier transform infrared/mass spectrometry. Gurka, D.F.; Titus, R. (Environmental Protection Agency, Las Vegas, NV). pp 17-23 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A capillary gas chromatography/Fourier transform infrared (GC/FT-IR) spectrometer has been linked to a Mass Selective Detector (MSD). A 10:1 effluent splitter was used to divert most of the GC effluent to the FT-IR cell and the remainder to the MSD. This system has been used to characterize the GC-volatile portion of dye and herbicide manufacturing wastes, sediments, and sludge extracts. Use of a 2300 member FT-IR spectral data base, in conjunction with the NBS mass spectral (MS) data base, greatly increases the number of on-line MS confirmations obtainable by this direct-linked system over that of the conventional EPA GC retention time method. Chromatographic separation on a single capillary GC column allows a direct one-to-one correlation of peaks in the FT-IR and MSD chromatograms. Although this MS detector is 10 to 100 times more sensitive than the FT-IR detector used, and although the MS search library is over 15 times larger than the FT-IR search library, for the samples analyzed it was determined that each detector provided approximately the same amount of useful structural data.

46250 Use of FTIR for automated identification of organic compounds frequently found on hazardous waste sites. Puskar, M.A.; Levine, S.P.; Geraci, C.L.; Lowry, S.P. (Univ. of Michigan, Ann Arbor). pp 25-32 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An automated direct mixture identification FTIR program, PAWMI, which is ruled based in format, was developed as a preliminary screening tool for unknown organics handled on remedial action sites. This program, combined with forward searching through a library of spectra, result in the ability to identify major volatile components of organic waste and possibly nonchromatographable components of interest. A hazardous waste sample, previously analyzed by GC-MS, was used as a demonstration of the two FTIR techniques abilities. The data generated by FTIR and GC-MS are compared.

46251 Tandem mass spectrometer for the detection of nitroaromatic compounds and other electronegative species in ambient air. Glish, G.L.; McLuckey, S.A.; McKown, H.S. (Oak Ridge National Lab., TN). pp 33-40 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A tandem mass spectrometer has been constructed consisting of a quandrupole mass filter followed by a time-of-flight mass spectrometer. Ions are generated in an atmospheric pressure ionization (API) source, which allows for detection of certain types of compounds in ambient air. The combination of API with this tandem mass spectrometer offers the potential to do real-time monitoring of targeted compounds that are of environmental and other concern.

46252 Computer-controlled system for rapid soil analysis of ^{226}Ra. Doane, R.W.; Berven, B.A.; Blair, M.S. (Oak Ridge National Lab., TN). pp 47-54 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A computer-controlled multichannel analysis system has been developed by the Radiological Survey Activities (RASA) Group at Oak Ridge National Laboratory (ORNL) for the Department of Energy (DOE) in support of the DOE's remedial action programs. The purpose of this system is to provide a rapid estimate of the ^{226}Ra concentration in soil samples using a 6 x 9-in. NaI(T1) crystal containing a 3.25-in. deep by 3.5-in. diameter well. This gamma detection system is controlled by a mini-computer with a dual floppy disk storage medium, line printer, and optional X-Y plotter. A two-chip interface was also designed at ORNL which handles all control signals generated from the computer keyboard. These computer-generated control signals are processed in machine language for rapid data transfer and BASIC language is used for data processing.

46253 Laboratory experience in the analysis of orphan waste. Leventhal, L.; Kharkar, D.P. (EAL Corp., Richmond, CA). pp 55-60 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Energy related low level radioactive waste mixed with inorganic and organic hazardous waste derive from all stages of the fuel cycle. In order to comply with EPA and NRC regulations, prior to disposal this waste must be analyzed. For the analytical laboratory, the samples comprise both a potential radiation and chemical hazard. Screening procedures for handling such samples are described. Sophisticated instrumentation is necessary to identify the contaminants with the sensitivity required by the EPA and NRC. Aliquotting and dilution techniques have been adequate to reduce the activity levels sufficiently to allow operations in an uncontrolled laboratory and meet the minimum detection levels. Higher level samples are analyzed in a controlled area employing dedicated instrumentation and health physics precautions.

46254 New laboratory robotic system for automated sample preparation and integrated analysis. Cerino, A.; Barrett, P.; Fisher, C.; McGrattan, B. (Perkin-Elmer Corp., Norwalk, CT). pp 63-75 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

For every sample that enters an analytical laboratory, a sequence of processes are performed. Comprehensive sample handling usually involves more than just analytical measurement and data handling. In most cases, some levels of sample preparation prior to the introduction to an analytical instrument is required. This preparation can be a simple dilution or a multistep procedure that can be time consuming and tedious. Until recently, sample preparation has been performed manually. These sample preparation procedures have been the missing element in the concept of total laboratory automation. The paper will present a new approach for automated sample preparation and integrated analysis. The system employed is based on the concept of flexible automation. It utilizes a 5-axis articulated arm with programmable speed and interchangeable fingers to physically move samples around the sample preparation area. The robot is controlled by an IBM Personal Computer in conjunction with a high-level robot programming language. This menu-driven software provides flexibility with its modular and extendable design. The system allows customized applications to be easily developed. Featured in the discussion will be an

integrated method including preparation and analysis for a typical gas chromatography sample. The routines that will be demonstrated will be suitable to a wide variety of applications.

46255 **Aluminum, boron, and mercury measurement via ion-exchange direct current argon plasma (DCAP) spectrometry.** Maxwell, S.L. III. (E.I. du Pont de Nemours and Co., Aiken, SC). pp 77-82 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC09-76SR00001.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The accurate measurement of aluminum, boron, and mercury in process dissolver solutions at the Savannah River Plant (SRP) is important. Costs for the processing of non-SRP uranium fuels are based in part on the measured aluminum content of the fuel. Boron is a nuclear safety control in some dissolutions and mercury(II) is a catalyst in the dissolution of uranium-plutonium oxide fuels. In analyses, ion exchange is used for selective separations and for removing high activity constituents in dissolver solutions prior to measurement via direct current argon plasma (DCAP) spectrometry. Aluminum is separated via anion exchange using oxalate-hydrochloric acid mixtures, boron is separated via cation exchange using 0.05 M nitric acid, and mercury(II) is separated via cation exchange using 40% ethanol-0.2 M hydrochloric acid. The aluminum content is measured with a precision of better than +- 1.0% (RSD) using gravimetric dilutions and sample measurements bracketted by standard measurements. Boron and mercury are measured with a precision of better than +- 3.0% (RSD) using volumetric dilutions.

46256 **Automated electron microprobe.** Thompson, K.A.; Walker, L.R. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN). pp 83-89 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The Plant Laboratory at the Oak Ridge Y-12 Plant has recently obtained a Cameca MBX electron microprobe with a Tracor Northern TN5500 automation system. This allows full stage and spectrometer automation and digital beam control. The capabilities of the system include qualitative and quantitative elemental microanalysis for all elements above and including boron in atomic number, high- and low-magnification imaging and processing, elemental mapping and enhancement, and particle size, shape, and composition analyses. Very low magnification, quantitative elemental mapping using stage control (which is of particular interest) has been accomplished along with automated size, shape, and composition analysis over a large relative area.

46257 **Automated instrument for qualitative analysis of photographically recorded spectra.** Hareland, W.A.; Melgaard, D.M. (Sandia National Labs., Albuquerque, NM). pp 91-98 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC04-76DP00789.

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An advanced technique has been developed for the identification of element spectral lines in photographically recorded emission spectra. It is based on measurement of the relative position of a line on the photoplate and calculation of the wavelength using an equation derived from measured positions of known spectral lines. With this technique, the wavelength of any line can be determined to within 0.04 Angstrom over a 1000 Angstrom region. The elements are identified by comparing the calculated wavelengths with known values in the MIT Wavelength Tables and verified based on the wavelengths of the most intense spectral lines. The automated instrument can be applied to the analysis of photographically recorded spark source mass spectra. Isotopes can be identified based on their mass-to-charge ratios which are calculated from the measured positions of the lines on the photoplate.

46258 **Polymer mass spectrometry: the problem ad its solution.** Cook, K.D.; Callahan, J.H.; Man, V.F.; Hool, K.O. (Univ. of Tennessee, Knoxville). pp 101-106 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

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Electrohydrodynamic mass spectrometry (EHMS) has been used as a particularly soft ionization technique to characterize the molecular weight distributions of polymers. Several factors can affect the efficiency of sampling ions from solution (as in EH, FAB, and thermospray MS). Important variables include ion pairing, charge, solvation, desolvation, diffusion, and surface activity. These may vary significantly among oligomers, thereby complicating quantitative interpretation of polymer mass spectra obtained by matrix assisted ionization. The extent of this variation will be considered, along with means for minimizing its impact. The relative magnitude of the various contributions to sampling bias will be discussed.

46259 **Sputter atomization/resonance ionization mass spectrometry for high sensitivity isotopic analysis.** Donohue, D.L.; Christie, W.H.; Goeringer, D.E.; Smith, D.H.; McKown, H.S. (Oak Ridge National Lab., TN). pp 113-118 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

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Resonance Ionization Mass Spectrometry (RIMS) combines the selectivity and sensitivity of resonance ionization spectroscopy (RIS) with high performance mass spectrometry. Results from our laboratory (1-5) and elsewhere (6-13) have been reported for a variety of elements using thermal vaporization sources to produce the atom reservoir for laser-induced resonance ionization. In this paper we describe the use of ion beam sputtering as an ultrasensitive method of atom formation for RIMS (14). A commercial ion microprobe mass analyzer (IMMA) has been interfaced with a tunable pulsed dye laser for carrying out resonance ionization mass spectrometry of sputtered atoms. This paper will describe the changes necessary to adapt the IMMA instrument for resonance ionization, along with preliminary results for the elements Sm and U.

46260 **Evaluation of the MAT-thermal ionization quadrupole mass spectrometer for potential use for on-situ safeguards verifications.** Fiedler, R. (International Atomic Energy Agency, Seibersdorf, Austria). pp 127-132 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

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The Thermoquad THQ of Finnigan MAT is a quadrupole mass spectrometer with a Faraday cup and a secondary electron multiplier. The multiplier is placed at an angle of 90 degrees to the axis of the quadrupole rods. The sample size was for solution loadings 1/μg of uranium. Resin bead loadings carry about 2 ng of sample material. Both types of loadings have been used to test the instrument. The accuracy as well as the internal and external precision have been studied on standards and real samples. The possibilities as well as the limitations of the instrument are discussed with regard to its potential use for on-site safeguards verification measurements.

46261 **ICP-MS and its application in a nuclear laboratory.** Long, S.E.; Brown, R.M. (AERE Harwell, England). pp 133-137 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

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Combination of the Inductively Coupled Plasma Source (CIP) with a quadrupole mass spectrometer (MS) has produced a sensitive, multi-element analytical technique (ICP-MS) which complements the capabilities of other methods and produces isotope ratio data in addition to total element concentration. One such commercial instrument is being evaluated at Harwell. Experience with

the technique will be discussed and factors such as sensitivity, precision and accuracy compared with that of other techniques, particularly ICP-ES. Emphasis is placed on a number of applications of the technique to problems associated with the nuclear industry. These include the determination of uranium in environmental samples, measurement of isotope ratios and the determination of impurities in alloys.

46262 **Application of inductively coupled plasma mass spectrometry to the analysis of uranium metal and uranium compounds.** Cantle, J.E. (VG Instruments, Stamford, CT). pp 139-142 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The analysis of trace impurities in uranium and its compounds has now become a routine requirement in all parts of the nuclear industry. Optical emission spectroscopy is used extensively to provide this analytical need for those elements for which suitable emission wavelengths exist. In many cases, however, pre-analytical chemical preparation steps must be taken such as separation of the uranium matrix, in order to avoid serious interferences. We have recently been investigating the potential of ICP-MS in this field of application. This technique shows much lower limits of detection in solution compared to OES, and moreover the mass spectra produced are simpler than optical spectra and are therefore easier to interpret. This paper will report on progress and failures so far, and will attempt to anticipate some of the future expectations.

46263 **Analytical applications of ICP-FTS.** Faires, L.M.; Palmer, B.A.; Cunningham, P.T. (Los Alamos National Lab., NM). pp 145-150 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

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The Analytical Chemistry Group of the Chemistry Division at Los Alamos National Laboratory has been investigating the analytical utility of the inductively coupled plasma (ICP) - Fourier transform spectrometer (FTS) combination. While a new state-of-the-art FTS facility is under construction at Los Alamos, preliminary data has been obtained on the one-meter FTS at the National Solar Observatory at Kitt Peak, Arizona. This paper presents an update of the Los Alamos FTS facility, which is expected to be completed in 1986, and presents data showing the analytical potential of an ICP-FTS system. Some of the potential problems of the multiplex disadvantage are discussed, and the advantages of the high resolution obtainable with the FTS are illustrated.

46264 **Electronic fourier transform spectroscopy: performance and application.** Bostick, W.D.; Armstrong, D.P.; Fletcher, W.H.; McCulla, W.H. (Oak Ridge Gaseous Diffusion Plant, TN). pp 151-158 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Recent advances in commercial instrumentation have extended the powerful technique of Fourier transform spectroscopy into the ultraviolet and visible spectral region, with inherent advantages which include: simultaneous multiwavelength detection, internal wavelength calibration, and adjustable resolving power. Performance with the Bomem DA3.01 instrument is examined by measurement of the visible emission produced by Ne and Hg calibration lamps and by continuous-wave HeNe, Ar^+, and tunable dye lasers.

46265 **Matrix isolation versus the light pipe as an interface for gas chromatography/fourier transform infrared spectrometry.** Schneider, J.F.; Demirgian, J.C.; Stickler, J.C. (Argonne National Lab., IL). pp 159-164 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract W-31-109-ENG-38.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Gas chromatography interfaced with Fourier transform infrared spectrometry (GC/IR) is a technique of rapidly growing importance in analytical chemistry. In this paper, the matrix-isolation interface for capillary GC/IR is compared with the light-pipe GC/IR interface. Gas chromatography/matrix-isolation/Fourier transform infrared spectrometry (GC/MI/IR) combines the separation power of capillary gas chromatography with the high sensitivity and specificity of matrix-isolation infrared detection. The results is a technique well suited to the detection and identification of trace quantities of organic compounds in complex samples. Representative spectra of a test mixture run on instruments using both interfaces are presented, and the advantages and disadvantages of both interfaces are discussed.

46266 **Comparison of different methods of determining plutonium content and isotopic composition.** pp 167-172 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC06-77RL01030.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

At Rockwell Hanford Operations, several different methods are used to determine plutonium content and isotopic composition. These include alpha particle energy analysis, calorimetry/gamma-ray analysis, mass spectrometry, and low energy gamma-ray assay. Each is used in a process control environment and has its advantages and disadvantages in terms of sample matrix, sample preparation, concentration, error ranges, detection limits, and turn around time. Of the methods discussed, special attention is paid to the Plutonium Isotopics Solution Counter, a low energy gamma-ray assay system designed to provide plutonium and americium content and isotopic composition of Pu-238 through Pu-241 and Am-241. It is qualitatively and quantitatively compared to the other methods. A brief description of sample types which the Solution Counter analyzes is presented.

46267 **High precision plutonium and uranium assay with an automatic titrator.** Sironen, R.J.; Angelo, T.B. (Rockwell International Corp., Golden, CO). pp 173-178 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

For a number of reasons it recently became advisable to adopt a different method for routine plutonium metal assay than had been in use at Rocky Flats. Earlier experience with the assay of plutonium nitrate solutions using a modified Corpel and Regnaud method had been highly successful. Subsequently the method was also successfully applied to plutonium metal and uranium metal assays. Consideration of automatic titration instrumentation led to the acquisition of a Mettler DL40 titrator. Precisions are typically less than .03% RSD with negligible bias. Assay methods and instrument operation are discussed.

46268 **Computer-assisted controlled-potential coulometer for the determination of plutonium.** Mitchell, W.G.; Lewis, K. (New Brunswick Lab., Argonne, IL). pp 179-184 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A computer controlled coulometer for maintaining the New Brunswick Laboratory's (NBL) state-of-the-art method of plutonium determination has been designed, assembled, and tested. The new coulometer, designed and built at NBL, replaces the modified M-T Electronics Co., Model 3, coulometer which is no longer commercially available. The new instrument incorporates the basic features of the NBL controlled-potential coulometric method for the determination of plutonium. Continuous electrical calibration gives factors with a RSD of better than calibration gives factors with a RSD of better than 0.002%. A comparison study of the original and new coulometers using a one way analysis of variance test for factor effect shows no statistically significant difference between the two instruments.

46269 Spectrophotometric determination of plutonium with high precision and heavy sample throughput. pp 185-190 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

With increased requirements for process control and accountability of nuclear materials in plutonium processing plants, this plutonium assay method was developed which has the capability of handling heavy sample loads and still provide precise results. Plutonium nitrate solutions are added to a solution of 2 M hydrochloric acid containing hydroxylamine. The plutonium content of solutions is determined by measuring light absorbances. It takes only 1 1/2 to 2 hours to analyze six samples. Plutonium standard recoveries better than 100.00% +- 0.025% at two sigma are possible with recoveries better than 100.0% +- 1.0% in routine operation.

46270 Nondestructive assay of plutonium residue in horizontal storage tanks. Marsh, S.F. (Los Alamos National Lab., NM). pp 191-196 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract W-7405-ENG-36.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Aqueous plutonium recovery and purification processes often involve the temporary storage of plutonium solutions in holding tanks. Because plutonium is known to precipitate from aqueous solutions under certain conditions, there is a continuing need to assay emptied tanks for plutonium residue. A portable gamma spectrometer system, specifically designed for this purpose, provides rapid assay of such plutonium residues in horizontal storage tanks. A means is thus available for the nondestructive analysis of these tanks on a regular schedule to ensure that significant deposits of plutonium are not allowed to accumulate.

46271 Multi-stage mass spectrometry with a quadruople mass filter interfaced to a high resolution sector mass spectrometer. McBay, E.H.; Glish, G.L.; McLuckey, S.A.; Bertram, L.K. (Oak Ridge National Lab., TN). pp 199-203 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A new tandem mass spectrometer has been constructed by interfacing a quadrupole mass filter to the front end of a conventional high resolution sector mass spectrometer. The resulting instrument, the first of its kind, offers a number of useful and, in some cases, new capabilities. These include, for example, high mass resolution on daughter ions, variable collision energy collisional activation, ion/molecule reactions at superthermal energies and a variety of multiple reaction experiments. These capabilities have been demonstrated, examples of which are shown and discussed.

46272 On-line analysis of plutonium by energy dispersive x-ray fluorescence. Parray, R.F.; Walker, V.W.; Johns, R.A.; Camp, D.C.; Ruther, W.D.; Eckels, D. (Savannah River Lab., Aiken, SC). pp 205-210 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC09-76SR00001.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An on-line energy dispersive K x-ray fluorescence analysis (XRFA) system has been developed to measure the plutonium concentration of process solutions at the Savannah River Plant (SRP). This system has consistently produced accountability quality measurements (< 0.5%) on-line in ~ 40 minutes of counting time. Comparisons to an independent coulometry method show agreement within sampling and analysis precision, typically 1%.

46273 On-line analyzer for monitoring uranium and technetium in the vent stacks to a gaseous diffusion plant. Powell, M.R.; Branam, D.A.; Morrow, R.W. (Oak Ridge Gaseous Diffusion Plant, TN). pp 211-217 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An automated electrochemical analyzer to provide continuous on-line measurement of volatile uranium and technetium compounds in the vents of a gaseous diffusion plant has been developed. The analyzer uses square wave polarography to measure uranium and technetium concentrations in an alkaline solution that has been used to scrub a known volume of the diffusion cascade vent gases. Uranium can be determined down to 0.12 μg/mL solution sensitivity (0.093 μg/L gas sensitivity at a flow rate of 4 L/min and a sampling time of 30 min), and technetium can be determined to concentrations of 0.018 μg/mL (0.014 μg/L).

46274 Imaging detector for X and gamma rays. McGonnagle, W.J. (New Brunswick Lab., Argonne, IL). pp 219-224 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A unique component of this imaging detector is the microchannel plant (MCP) electron multiplier. Electron multiplication of 10^3-10^7 can be obtained using MCP's. The image can be observed visually, recorded on film, measured quantitatively by use of photodiode arrays or low level TV cameras. This detector can be used to image distributed sources such as containers of radioactive materials, and hold up in pipes or equipment. Provided with a point source of radiation it can be used for fluoroscopy or real time radiography. Applications, both qualitative and quantitative, in nuclear applications, safeguards, medicine, industry and x-ray diffraction are presented.

46275 Production and certification of an equal atom plutonium isotopic standard - the New Brunswick Laboratory certified reference material (CRM) No. 128. Cacic, C.G.; Crawford, D.W. (New Brunswick Lab., Argonne, IL). pp 231-238 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The US Department of Energy (DOE), New Brunswick Laboratory (NBL) has produced an equal atom $^{239}Pu/^{242}Pu$ isotopic standard, NBL CRM No. 128. Provisional certification of this standard relative to uranium was completed in 1984 and the material made available for distribution to the nuclear community. Certification of the $^{239}Pu/^{242}Pu$ ratio on an absolute basis has now been accomplished using highly accurate and precise chemical and mass spectrometric measurement techniques. The absolute certification of NBL CRM No. 128 has established it as the primary reference for calibrating the measurement of plutonium isotopic ratios.

46276 Multi-column step-gradient chromatography system for automated ion exchange separations. Rucker, T.L. (Oak Ridge National Lab., TN). pp 239-245 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A multi-column step-gradient chromatography system has been designed to perform automated sequential separations of radionuclides by ion exchange chromatography. The system consists of a digital programmer with automatic stream selection valve, two peristaltic pumps, ten columns, and a fraction collector. The automation allows complicated separations of radionuclides to be made with minimal analyst attention and allows for increased productivity and reduced cost of analyses. Results are reported for test separations on mixtures of radionuclides by the system.

46277 Robotic sample preparation for radiochemical plutonium and americium analyses. Stalnaker, N.; Beugelsdijk, T.; Thurston, A.; Quintana, J. (Los Alamos National Lab., NM). pp 247-250 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract W-7405-ENG-36.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A Zymate robotic system has been assembled and programmed to prepare samples for plutonium and americium analyses by radioactivity counting. The system performs two procedures: a simple dilution procedure and a TTA (xylene) extraction of plutonium. To perform the procedures, the robotic system executes 11 unit operations such as weighing, pipetting, mixing, etc. Approximately 150 programs, which require 64 kilobytes of memory, control the system. The system is now being tested with high-purity plutonium metal and plutonium oxide samples. Our studies indicate that the system can give results that agree within 5% at the 95% confidence level with determinations performed manually.

46278 Laser fluorimeter for uranium detection in waste. Schoof, S.; Mainka, E.; Hellmund, E. (Institut fuer Radiochemie, Germany, F.R.). pp 251-259 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A laser fluorimeter will be described which was built to determine the concentration of uranium and possibly other elements in waste arising in reprocessing plants. It is possible to measure with this fluorimeter both active samples in a glovebox and inactive samples outside. Recording and subsequent handling of measured data is fully automated by use of a personal computer. The fluorimeter is suited to record fluorescence spectra and fluorescence decay curves. Concentration of fluorescing materials can be determined even in the presence of fluorescence quenchers. First results show that uranium concentrations down to 0.5 ppb can be measured when uranium is excited in the form of a phosphate complex. The influence exerted by various quenchers found in waste on the uranium fluorescence decay and on uranium concentration measurements was investigated.

46279 Design and application of a new data system: DS90. Warburton, G.A.; Rayn, P.A.; Chadwick, K.; Greathead, R.J. (Kratos Analytical, Manchester, England). pp 261-262 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

DS90 MS data system is a versatile control, acquisition and processing system. It incorporates facilities to allow operation of either magnetic sector or quadrupole instruments - including multi sector or hybrid instruments. Full control of a LC/GC-MS-DS is provided by distributed microprocessors, accessed and controlled through DS90. Presented here are some novel aspects of DS90 control and acquisition as well as data to illustrate the post-acquisition data handling facilities.

46280 Detecting isotopic ratio outliers. Bayne, C.K.; Smith, D.H. (Oak Ridge National Lab., TN). pp 265-273 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An alternative method is proposed for improving isotopic ratio estimates. This method mathematically models pulse-count data and uses iterative reweighted Poisson regression to estimate model parameters to calculate the isotopic ratios. This computer-oriented approach provides theoretically better methods than conventional techniques to establish error limits and to identify outliers.

46281 Investigations of fluctuations in instrumental responses by principal components analysis. Wangen, L.E.; Bentley, G.E.; Hamilton, V.T.; Peterson, E.J. (Los Alamos National Lab., NM). pp 285-291 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Principal components analysis was evaluated as a chemometric method for investigating the sources of variation in multicomponent analytical instruments. Many measurements of a 20-element standard were made over several days of operation with a direct-current argon plasma emission spectrometer designed to simultaneously measure the emission intensity at 20 analytical wavelengths. The number of components necessary to account for signal variations and the interelement correlations were determined by a principal components analysis. These results were used to identify the minimum number of independent sources of instrument variation and therefore the minimum number of internal standards need to correct nonrandom fluctuations in instrument response. Correlations of the analytical signals with the principal components provide guidance for selecting internal standards.

46282 Optimization and experimental design in analytical chemical methods development. Deming, S.N. (Univ. of Houston, TX). pp 293-297 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Most analytical chemical methods development requires the optimization of a response (e.g., analytical sensitivity) as a function of several experimental variables (factors: e.g., pH, reagent concentration, temperature). For many analytical chemical methods involving continuous factors, the sequential simplex technique has been found to be a highly efficient experimental design strategy that gives improved response after only a few experiments. After the sequential simplex technique has found the region of optimum response, classical experimental designs and regression analysis of the results provides detailed information about factor effects and interactions. An additional benefit of simplex optimization followed by classical experimental designs involves quality control: methods that have been optimized tend to operate in flat regions of the response surface. This flatness gives greater immunity to factor variations and greatly increases the ruggedness of the methods.

46283 Real-time analysis using the Kalman filter. Brown, S.D. (Washington State Univ., Pullman). pp 299-307 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract FG06-84ER13202.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Recent trends in analytical sensor development have created considerable interest in on-line methods of chemical analysis, where chemical species concentrations are estimated in real time. The Kalman filter is an ideal means by which the analysis of these data can be accomplished, and, if desired, some type of control loop implemented. However, there are many different approaches to Kalman filtering; not all are well-suited to rapid and accurate analysis of chemical data. This paper discusses factors which determine what algorithm should be employed, and it demonstrates the feasibility of real-time filtering by analyzing spectral data obtained on a reacting system.

46284 Application of ICP/MS in the analysis of uranic materials. Allenby, P.; Clarkson, A.S.; Makinson, P. (British Nuclear Fuels plc, Lancashire, England). pp 317-323 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An Inductively Coupled Plasma mass spectrometer, the Vacuum Generators (VG) PlasmaQuad is being evaluated for the determination of metallic impurities in uranic materials. This paper describes the problems encountered and gives instrumental condi-

tions for the direct determination of Ti, V, Zr, Nb, Mo, Ru, Sb, Hf, Ta and W in uranyl nitrate liquors. Limits of detection for different nebulizer systems are quoted. These are compatible with the USDOE specification limits for these impurities in uranium hexafluoride.

46285 **Reversed phase chromatographic separations with tri-n-octyl phosphine oxide for the isotopic and isotope dilution analysis of mixed U, Pu nuclear fuel materials.** Delle Site, A.; Doubek, N.; Fiedler, R.; Raab, W.; Swietly, H.; Bagliano, G.; Deron, S. (International Atomic Energy Agency, Seibersdorf, Austria). pp 325-335 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Accountability and safeguards verification analyses of mixed uranium-plutonium nuclear materials require that practical and efficient procedures be available for selective separations of americium, plutonium and uranium. A reversed phase procedure was defined for the analysis of mixed U, Pu nuclear reactor fuel materials is described, using a single column for the successive separation of the elements of interest by reverse phase chromatography on a stationary phase of tri-n-octyl phospine oxide. The procedure is suitable for the complete isotopic analyses of plutonium and uranium by mass spectrometry, the determination of the isotope abundances of Pu-238 by alpha spectrometry, as well as for the isotope dilution assays of plutonium and uranium. Results of tests, performed in particular with reference materials, indicate that the separation allows to achieve the ESARDA-1983 target values of precision and accuracy. Limitations of the procedure are discussed.

46286 **Description of apparatus for determining radiological source terms of nuclear fuels.** Baldwin, D.L.; Woodley, R.E.; Holt, F.E.; Archer, D.V.; Steele, R.T.; Whitkop, P.G. (Westinghouse Hanford Co., Richland, WA). pp 345-351 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

New apparatus have been designed, built and are currently being employed to measure the release of volatile fission products from irradiated nuclear fuel. The system is capable of measuring radiological source terms, particularly for cesium-137, cesium-134, iodine-129 and krypton-85, in various atmospheres at temperatures up to 1200 degrees C. The design allows a rapid transient heatup from ambient to full temperature, a hold at maximum temperature for a specified period, and rapid cooldown. Released fission products are measured as deposition on a platinum thermal gradient tube or in a filter/charcoal trap. Noble gases pass through to a multichannel gamma analyzer.

46287 **Automated analyzer for the determination of free acid.** Young, J.E.; Maxwell, S.L. III. (Savannah River Lab., Aiken, SC). pp 353-357 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC09-76SR00001.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The determination of nitric acid concentration is essential for virtually every phase of nuclear fuel reprocessing operations. Baumann and Torrey have developed a manual method for the determination of free acid in the presence of hydrolyzable metal ions such as Al(III), Cr(III), Fe(III), Hg(II), Ni(II), Th(IV), and U(VI). Potassium thiocyanate complexes these ions to prevent interference in the standard addition method. The manual method has been used in our laboratory with great success. This paper presents a fully automated system for free acid determination which improves overall precision and significantly reduces the time of analysis. When compared to the manual method, precision is improved from +/- 8.0% to +/- 5.2% (2 RSD) for the 47-member technician pool. Hands-on analytical time is reduced from 5 minutes to 1 minute per sample. Precision for a single chemist performing the analysis is +/- 0.7%. The method has been implemented for routine Purex process control. Analyzers have been installed in both shielded cell and bench locations.

46288 **Method for the recovery of silver from silver zeolite.** Reimann, G.A. (to Dept. of Energy). US Patent Application 6-708,618. 5 Mar 1985. 15p. Contract AC07-76ID01570. DE86013783 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013783.

High purity silver is recovered from silver exchanged zeolite used to capture radioactive iodine from nuclear reactor and nuclear fuel reprocessing environments. The silver exchanged zeolite is heated with slag formers to melt and fluidize the zeolite and release the silver, the radioactivity removing with the slag. The silver containing metallic impurities is remelted and treated with oxygen and a flux to remove the metal impurities. About 98% of the silver in the silver exchanged zeolite having a purity of 99% or better is recoverable by the method.

46289 **New detection methods and techniques with applications in liquid chromatography.** Wilson, S.A. Ames, IA; Iowa State Univ. (1985). 109p. University Microfilms Order No. 86-04,531.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Improvements in instrumental techniques for use in liquid chromatography (LC) used in detection and in the methods by which detectors are used to obtain information are reported. Results of two projects in which new detection techniques are demonstrated are described. Both of these techniques take advantage of the unique properties of lasers as light sources. The first technique is a laser-based three-dimensional detector which allows simultaneous monitoring of the refractive index, absorbance, and fluorescence from a flowing stream. Using the laser's ability to be focused to a very small spot, a one-microliter cell was built allowing compatibility with microbore column LC. The second technique is a laser-based absorbance detector which allows one to make differential absorbance measurements, optically using Michelson interferometry. A novel detection method is shown to work with two common LC detectors: the absorbance detector and the electrical conductivity detector. The absorbance detector works as a universal detector when an absorbing eluent is used, allowing one to detect nonabsorbing analytes. This mode of detection, along with the new detection scheme, is shown to allow analytes to be quantified without the need for standards. The same detection scheme is demonstrated with the conductivity detector, with nonsuppressed ion chromatography.

46290 **Photochemical separation of metals in aqueous solution.** Donohue, T. (Naval Research Lab., Washington, DC). *Chemical Physics Letters;* 48: No. 1, 119-121(15 May 1977). Contract AI01-76ET32016.

Several d-block transition elements have been separated from mixtures by photochemical means, using lines from various lasers. The species involved, oxalato complexes of Fe and Co, exhibit selective photoreduction following absorption in bands in the visible and near ultraviolet regions of the spectrum. This experiment is apparently the first demonstration of selective laser photochemistry in liquid phase mixtures of chemically related elements. 24 references, 1 figure, 1 table.

4002 Inorganic And Physical Chemistry

REFER ALSO TO CITATION(S) 45751, 45752, 45753, 46074, 46199, 46238, 46245, 46321, 46322, 46324

46291 **(CONF-851286—1) Pulsed EPR studies of small reactive radicals produced by ionizing radiation.** Lawler, R.G. (Brown Univ., Providence, RI (USA). Dept. of Chemistry). 1985. Contract AC02-82ER12042. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013389.

From Symposium on magnetic resonanace of excited state molecules; Kyoto, Japan (21 Dec 1985).

For several years we have participated in a collaborative research effort to apply the pulsed EPR-pulse radiolysis technique to several problems associated with the dynamics of small reactive radicals formed during radiolysis of aqueous solutions using 3 MeV electrons from a Van de Graaff accelerator. We will discuss experimental techniques and applications arising from this work, with particular emphasis on problems requiring high initial radical con-

centrations and EPR time resolution of one microsecond or better. 2 figs., 2 tabs.

46292 (ZfI-Mitt—99) Report of the Central Institute for Isotope and Radiation Research. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung; Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). Dec 1984. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE86780479.

Separate abstracts were prepared for individual papers in this report.

46293 Structure and chemisorptive properties of the Pt_3Ti surface. Bardi, U.; Dahlgren, D.; Ross, P.N. (Universita di Firenze, Italy). *Journal of Catalysis;* **100**: No. 1, 196-209(Jul 1986). Contract AC03-76SF00098.

Low-energy electron diffraction (LEED), X-ray photoelectron spectroscopy (XPS), and Auger electron spectroscopy (AES) were used to determine the structure and composition of the surfaces of [111] and [100] oriented crystals of an ordered alloy of bulk stoichiometry Pt_3Ti. Thermal desorption spectroscopy (TDS) was used to study the adsorption of carbon monoxide and hydrogen on these surfaces. The clean, annealed surface of [111] orientation has the ordered structure expected from truncation of the bulk crystal, consisting of alternating atom rows of (50% Pt + 50% Ti) and 100% Pt. The surface of [100] orientation also has a regular truncation structure with the outermost layer being 50% Ti in a c(2 x 2) lattice and the second layer, the 100% Pt layer. At near-ambient temperature, the adsorption of CO at the Ti sites is dissociative and at the Pt sites, molecular. The orderly substitution of Ti for Pt atoms in the surface changes the Pt-Pt pair site distribution such as to eliminate most of the sites for bridge bonding of the CO molecule. Only a single symmetric TDS peak was observed for CO desorbing from the alloy surface, as opposed to the asymmetric peak shape observed from pure Pt surfaces, which the authors suggest is a consequence of bridge-site elimination. At low temperature (230 K), a second molecular state of CO was observed which the authors assigned to a predissociative state on Ti sites with CO lying parallel to the surface. No hydrogen could be observed to desorb from clean annealed Pt_3Ti surfaces dosed with hydrogen at room temperature. Unfortunately, the authors were not able to distinguish between the possibilities (1) that hydrogen does not adsorb on the surface at room temperature, and (2) that hydrogen adsorbed at room temperature is not desorbed by flashing the surface temperature to ca. 900 K.

46294 Nitrogen desorption in the reaction of nitric oxide on carbon-supported platinum catalysts. Lim, K.J.; Loeffler, D.G.; Boudart, M. (Stanford Univ., CA). *Journal of Catalysis;* **100**: No. 1, 158-166(Jul 1986).

The catalytic decomposition of nitric oxide on carbon- and γ-alumina-supported platinum was studied in a quartz flow reactor between 423 and 623 K. The measured turnover frequency, defined as the number of nitric oxide molecules reacting per surface platinum atom per second, was an order of magnitude higher on the carbon-supported catalysts than on the alumina-supported catalyst or than that projected from earlier work on platinum foil. The rate-determining step for nitric oxide decomposition on Pt/Al_2O_3 or Pt foil appears to be the chemisorption of NO on platinum, with inhibition by oxygen, the most abundant reaction intermediate (mari) in equilibrated chemisorption on the same sites as those required for NO chemisorption. By contrast, it appears that on surrounding carbon support, producing CO and CO_2. The kinetic data suggest that the mari now consists of adsorbed nitrogen atoms. The second-order rate constant k for the associative desorption of nitrogen from platinum obtained for the work is compared with that extracted from published data on NH_3 decomposition or that measured directly by temperature-programmed desorption of nitrogen from platinum. It is found that for k a preexponential factor of 5×10^{-9} $cm^2 s^{-1}$ and an activation energy of 88 kJ mol^{-1}, in remarkable agreement with those reported by others.

46295 CO adsorption on (111) and (100) surfaces of the Pt_3Ti alloy: evidence for parallel binding and strong activation of CO. Mehandru, S.P.; Anderson, A.B.; Ross, P.N. (Case Western Reserve Univ., Cleveland, OH). *Journal of Catalysis;* **100**: No. 1, 210-218(Jul 1986). Contract AC03-76SF00098.

An atom superposition and electron delocalization molecular orbital (ASED-MO) study has been made of CO adsorption on a 40-atom cluster model of the (111) surface and a 36-atom cluster model of the (100) surface of the Pt_3Ti alloy. Parallel binding to high-coordinate sites associated with Ti and low CO bond scission barriers are predicted for both surfaces. The preference for parallel adsorption is a consequence of the nature of the CO π=to-surface donation interactions. On Ti sites the π orbitals donate to the early empty Ti 3d band and the antibonding counterpart orbitals are empty. Thus the π donation makes substantial contributions to the adsorption bond order that are in addition to the contributions from 5 σ donation and metal backbonding to the π/sup */ orbitals. Altogether these bonding interactions favor the lying down orientation. On Pt sites, on the other hand, the π donation antibonding counterpart orbitals are occupied so that the net interaction with Pt is a closed-shell repulsion. CO bonds upright in order to minimize the π interaction, and concomitantly, the closed-shell repulsion, while maintaining 5σ donation and π/sup */ backbonding stabilizations. Comparisons are made with the results for a 40-atom cluster model of the unalloyed Pt(111) surface. It is shown that the extended Hueckel parameterization is inappropriate for studying CO and adsorption to Pt with ASED-MO theory because it incorrectly favors adsorption bonding through the oxygen end.

46296 Rule of thumb for binary isotope separations in a gas centrifuge. Berger, M.H. (Oak Ridge Gaseous Diffusion Plant, TN). *Separation Science and Technology;* **21**: No. 4, 383-392(Jun 1986).

A simple hypothetical model of the binary isotope separation process in a modern countercurrent Gas Centrifuge is proposed. Like the usual Cohen-Onsager separation theory, internal fluid dynamics are obviously involved. But unlike that theory it completely obviates the flow integrals for Cohen's E, thereby allowing an immediate estimate of the flow efficiency of a given design by visual inspection of the flow field. At times this should be checked later by the usual analyses. To shed some light on this idea, derivations for two simple assumed idealized hydrodynamics are given, but a rigorous proof remains an open question. Then the hypothesis is tested against a battery of about 10 new exact formulas for E based upon analytical solutions to several variants of Onsager's pancake equation and is found to be reasonably accurate and surprisingly robust. Finally, some limitations of the rule are explored.

46297 High-resolution cw resonance ionization mass spectrometry. Whitaker, T.J.; Cannon, B.D.; Bushaw, B.A. (Pacific Northwest Lab., Richland, WA). pp 107-112 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC06-76RL01830.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

We have used continuous-wave (cw) lasers to produce efficient, isotopically selective ionization of barium in the source region of a quadrupole mass spectrometer. The technique involves two low-power, high-resolution dye lasers for the resonance steps and a 100 watt cw Nd:YAG laser for photoionization. The use of cw lasers offers both better duty cycle and much better resolution than is possible with pulsed lasers. We have observed an isotopic selectivity of 800 between ^{137}Ba and ^{138}Ba in the cw resonance process. Ionization efficiency is estimated to be about 10^{-4} and simple improvements should improve this value to near unity.

46298 Separation of rare earth isotopes using resonance ionization time-of-flight mass spectrometry. Armstrong, D.P.; McCullar, W.H.; Schweitzer, G.K. (Oak Ridge Gaseous Diffusion Plant, TN). pp 119-125 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Stable isotopes comprise a very large portion of the periodic table. They find a wide variety of applications, which include serving as precursors for radioisotopes and radipharmaceuticals and as accelerated particle targets. Isotopes of the lanthanides, with very high boiling points and low natural abundances, are often difficult to separate by conventional electromagnetic techniques. Photoionization is a potential alternative method. We have devised a system in which an atomic beam of the rare earth metal is admitted to the ionization region of a time-of-flight mass spectrometer. Photoionization is achieved using a pulsed, two-photon laser scheme. Preliminary results from the photoionization of samarium are discussed.

46299 **Pressure-induced torsional isomerism in $[n\text{-}Bu_4N]_2[Re_2X_8]$ (X = Br, I).** Carroll, T.L.; Shapley, J.R.; Drickamer, H.G. (Univ. of Illinois, Urbana). *Journal of the American Chemical Society;* 107: No. 20, 5802-5803(1985). Contract AC02-76ER01198.

The structural hallmark of the metal-metal quadruple bond, first characterized in $[Re_2Cl_8^{2-}]$, is an eclipsed conformation of the two ML_4 halves of the molecule, despite the resulting steric interactions. Twisted conformations, however, can be induced in certain cases by ligands bridging the two metal centers. The authors wish to report evidence that high pressure applied to salts of both $[Re_2I_8^{2-}]$ and $[Re_2Br_8^{2-}]$ causes torsion from an eclipsed to a staggered conformation.

46300 **Synthesis and characterization of some reduced ternary and quaternary molybdenum oxide phases with strong metal-metal bonds.** Lii, K.H. Ames, IA; Iowa State Univ. (1985). 330p. University Microfilms Order No. 86-04,489.Contract W-7405-ENG-82.

Thesis (Ph. D.).

In the course of the research on reduced ternary and quaternary molybdenum oxides, very interesting compounds with strong metal-metal bonds were discovered. Among these solid-state materials are found discrete cluster arrays and structures with extended metal-metal bonding. Further study in this system has revealed that many new structures exist in this new realm. The synthesis, structures, bonding, and properties of these new oxides are presented in this thesis.

46301 **Reduction of transition metal complexes by tris(bipyridyl)ruthenium(1+) ion, chromium(II) ion, and the 10-hydroxy-1-methylethyl radical.** Connolly, P. II. Ames, IA; Iowa State Univ. (1985). 153p. University Microfilms Order No. 86-04,455.Contract W-7405-ENG-82.

Thesis (Ph. D.).

The kinetics and mechanisms of the reactions of photochemically generated tris(bipyridyl)ruthenium(1+) ion with various metal complexes were studied. The rates of reduction of some Co(III) complexes were at, or near, the diffusion controlled limit. Several rare earth ions, Eu^{2+}, Yb^{2+}, and Sm^{2+} were also reacted with the ruthenium(1+) complex. Yb^{2+} was reduced; however, the reaction was just above the limits of detection. Sm^{2+} was not reduced, in accord with the thermodynamics of the reaction. The reductions of some Cr(III) complexes, including pentaaquo(organo)chromium(2+) ions and pentaaquo(pyridine)chromium(3+) ions, were also studied. The reduction of the organochromium(2+) complexes proceeded at a rate that was similar to the $Cr(H_2O)_6^{2+}$ ion. The homogeneous catalytic production of H_2 from reduced metal halide solutions (M^{2+} = Cr^{2+}, Eu^{2+}, V^{2+}) is presented. The catalyst is a cobalt(II) macrocyclic complex, $Co(dmgBF_2)_2$, which is reduced by the M^{2+} ions to form, ultimately, a hydridometal complex. This complex leads to the evolution of H_2 in the acidic solutions employed. The mechanism of the reaction is discussed in terms of the Michaelis-Menten scheme for enzyme catalysis. A photochemical method for the generation of 1-hydroxy-1-methylethyl radical for kinetic study is presented. This radical is reacted with $BrCo(dmgH)_2$ and $ClCo(dmgH)_2$ to produce the highly colored $Co(dmgH)_2$ complex, which serves as the indicator for the reaction.

46302 **Synthesis and characterization of compounds containing discrete tetranuclear clusters and extended arrays of molybdenum atoms.** Aufdembrink, B.A. Ames, IA; Iowa State Univ. (1985). 296p. University Microfilms Order No. 86-04,443.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Improved synthetic pathways to the $Mo_4Cl_8L_4$ cluster compounds were elucidated which provide a facile entrance to the synthesis of new four metal atom clusters. The new tetranuclear clusters, with the stoichiometry $R_4Mo_4Cl_{12}$ (R = Et_4N, Pr_4N, O_4P), were prepared by the reaction of tealkylammonium or tetraphenylphosphonium chlorides with the rectangular tetrameric cluster $Mo_4Cl_8L_4$. One electron oxidation of $Mo_4Cl_{12}^{4-}$ by I_2 or dichlorophenyliodine yielded the $Mo_4Cl_{12}^{3-}$ cluster anion, which was shown to exist as two geometric isomers, both of which are fragments of the larger hexanuclear cluster anion $Mo_6Cl_{14}^{2-}$. The metal atoms in $(Et_4N)_3Mo_4Cl_{12}$ form an opened tetrahedron or butterfly. In $[O_4P]_3Mo_4Cl_{12}$, $[Pr_4N]_3\text{-}Mo_4Cl_{12}$, and $[O_4As]_3[Et_4N]Mo_4Cl_{12}$ the metal atoms form a planar rhomboidal cluster unit. Bond distances in both cluster units are indicative of strong metal-metal bonding. Magnetic susceptibility and electron paramagnetic resonance studies of $[O_4P]_3Mo_4Cl_{12}$ are consistent with the assignment of one unpaired electron, delocalized over the cluster unit. The ternary molybdenum oxide, Sn/sub 0.9/Mo_4O_8, was synthesized by high temperature reactions in sealed molybdenum tubes. The structure of this compound is dominated by metal-metal bonded octahedral clusters which are fused on trans edges to form infinite chains through the lattice. Four such clusters are interconnected to form a tetragonal tunnel occupied by Sn. Resistivity studies show the compound is metallic. The compound exhibits weak, temperature independent paramagnetism.

46303 **Hybrid Patterson-superposition/direct-method approach to the x-ray phase problems, and in-lab EXAFS techniques.** Lii, S.L.W. Ames, IA; Iowa State Univ. (1985). 242p. University Microfilms Order No. 86-04,490.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Patterson manipulation methods and direct methods, such as those employing the well-known Σ_2 relation, are often viewed as being distinctly different approaches to structure determination. A method which combines the two approaches while retaining the advantages of both was developed. The basic assumption used in the method is that rho^2 ~ M/sub ps/.rho where rho and M/sub ps/ are the electron density and Patterson superposition functions, respectively. This results in a Σ_2-like relation in reciprocal space in which one of the E's in the product is replaced by G, a structure factor-like quantity obtained from a Fourier transform of the Patterson superposition function. This new relation has been proven to be effective in both centric and acentric cases. The details of the theory and its application to both model and real structures are presented. The construction and development of an in-lab EXAFS facility using a rotating anode X-ray source are presented. These include spectrometer alignment, automation, tests of the electronic detector systems, improvement of the energy resolution and development of both data acquisition and data reduction programs.

46304 **Metal-oxygen systems.** Altstetter, C.J. (Univ. of Illinois, Urbana-Champaign). *Bulletin of Alloy Phase Diagrams;* 5: No. 6, 543-553(1984). Contract AC02-76ER01198.

An overview of metal-oxygen systems with an emphasis on the metal-rich solid solutions is presented. Topics treated include: metal-oxygen equilibria, metals in high-temperature oxidizing environments, oxygen solubility, oxygen-solute interactions, free energies of solution of oxygen in liquid metals such as copper, solubility of metal oxides in the solid metals, phase diagrams of metal-oxygen systems, changes in properties, periodic behavior, enthalpies of formation and of solution of various systems, thermodynamic studies, oxygen diffusion studies, trapping and trapping energies, and study of defects.

46305 **Oxidation mechanisms and catalytic properties of the actinides.** Colmenares, C.A. (Lawrence Livermore National Lab., CA). *Progress in Solid State Chemistry;* 15: 257-264(1984).

The study of actinide-element oxidation has been an ongoing project at several of the National Laboratories in the US and some of the European research institutes. The author has been involved in this task at LLNL for approximately the last 15 years. During this time he has explored the oxidation kinetics and surface reactivity of thorium and uranium, and some of the catalytic properties of ThO_2. The work on the oxidation of thorium was published recently and a summary is included in this review. On the other hand, some of the kinetics and mechanisms of uranium oxidation are presented in this review for the first time. A complete review is included of the early stages of oxidation for both thorium and uranium. The author emphasizes those measurements taken with surface-sensitive and optical spectroscopies because they provide a good experimental basis for mechanistic interpretations of kinetic data. All pertinent data to January 1984 is included. 244 references, 36 figures, 28 tables.

46306 **Charge transfer in rare earth-trichloride graphite intercalation compounds.** Boolchand, P.; Lemon, G.; Bresser, W.J.; McDaniel, D.H.; Eklund, P.C.; Heinz, R.E.; Stumpp, E.; Nietfeld, G. (Univ. of Cincinnati, OH). *Solid State Communications;* 52: No. 7, 675-679(1984). Contract AS05-81ER10936;FG05-84ER45151.

Results are reported of ^{151}Eu Moessbauer and optical reflectivity measurements on intercalation compounds formed either by the reaction of graphite with $EuCl_3$, or with $EuCl_3$:$AlCl_3$ mixtures, in the presence of Cl_2. Results on graphite flakes and highly-oriented-pyrolytic graphite (HOPG) indicate the presence of a single narrow Moessbauer line characteristic of Eu^{3+}, which the authors identify with intercalated $EuCL_3$. No evidence for Eu^{2+} was found in the Moessbauer spectra. Since Eu^{3+} is the most easily reduced of the rare earth ions, it was concluded that no reduction of any rare earth trichlorides takes place under similar conditions of intercalation. The optical reflectance spectrum of the HOPG-$EuCl_3$-Cl_2 exhibits a sharp Drude edge at ~1.2 eV consistent with metallic conduction and a moderate charge transfer. These results taken collectively suggest that the enhanced metallic conductivity in rare earth chloride intercalation compounds is associated with charge transfer from the graphite to the co-intercalated Cl_2 forming Cl^- and is consistent with measured stoichiometries C/sub n/EuCl/sub 3 + δ/, where $\delta \approx 0.2$. 15 references, 3 figures, 1 table.

4003 Organic Chemistry

REFER ALSO TO CITATION(S) 45603, 45606, 45621, 46291, 46301, 46302, 46303, 46322, 46643

46307 **(LA-UR—86-2181) Unusual bond paths in organolithium compounds.** Bachrach, S.M.; Ritchie, J.P. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-8606165—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012441.

From Data systems users working group meeting of the Space Physics Analysis Network (SPAN); Greenbelt, MD, USA (8 May 1986).

We have applied the topological method to a number of organolithium compounds. The wavefunctions were determined with GAUSSIAN-82 using 3-21G basis set and fully optimized geometries. Gradient paths were obtained using the RHODER package and critical points were located using EXTREME. These results indicate the unusual nature of organolithium compounds. The strange bond paths arise mainly from the ionic nature of the C-Li interaction. We suggest that the term "bond path" may best be suited for covalent bonds. 4 figs., 1 tab.

46308 **Isotope effects in arene C-H bond activation by [(C_5Me_5)Rh(PMe_3)].** Jones, W.D.; Feher, F.J. (Univ. of Rochester, NY). *Journal of the American Chemical Society;* 108: No. 16, 4818-4819(6 Aug 1986). Contract AC02-83ER13095.

The isotope effects involved in the activation of arene C-H bonds by the intermediate [(C_5Me_5)Rh(PMe_3)] have been investigated. The ratio k/sub H/k/sub D/ for coordination to a double bond in benzene (the rate-determining step of arene activation) is found to be 1.05 (6), whereas k/sub H//k/sub D/ = 1.4 for the second step in which the C-H bond of the coordinated arene undergoes oxidative addition. The isotope effect K/sub H/D/ for the equilibrium between the more stable phenyl hydride complex (C_5Me_5)Rh(PMe_3)(C_6D_5)H and the complex containing hydrogen in the ortho position of the phenyl ring (C_5Me_5)Rh(PMe_3)(o-C_6D_4H)D shows a preference for hydrogen (vs. deuterium) on the metal of 2.7. The kinetic isotope effect for reductive elimination and dissociation of m-xylene from (C_5Me_5)Rh(PMe_3)(3,5-$C_6H_3Me_2$)H vs. (C_5Me_5)Rh(PMe_3)(3,5-$C_6H_3Me_2$)D is found to be inverse, with k/sub H//k/sub D/ = 0.51. Analysis of the data for the deuterated benzene derivatives confirms that the kinetic isotope for the reductive elimination step is inverse. Attempts to prepare the complex (C_5Me_5)Rh(PMe_3)(CH_3)D by reduction of [(C_5Me_5)Rh(PMe_3)(CH_3)(THF)]$^+$ with [BEt_3]$^-$ resulted in the formation of both (C_5Me_5)Rh(PMe_3)(CH_3)D and (C_5Me_5)Rh(PMe_3)(CH_2D)H.

46309 **Inter- and intramolecular insertion of rhenium into carbon-hydrogen bonds.** Wenzel, T.T.; Bergman, R.G. (Univ. of California, Berkeley, CA). *Journal of the American Chemical Society;* 108: No. 16, 4856-4867(6 Aug 1986). Contract AC03-76SF00098.

$CpRe(PMe_3)_2$ (1) was synthesized in 38% yield by Na/Hg reduction of $ReCl_2(PMe_3)_4$ (3) with cyclopentadiene. UV irradiation of 1 in benzene and cyclopropane liberated PMe_3 and gave in respective C-H insertion products Cp-(PMe_3)$_2$Re(Ph)H (4, 64%) and Cp(PMe_3)$_2$Re(c-C_3H_5)H (5, 38%). Irradiation of 1 in n-hexane or cyclopentane provided Cp(PMe_3)$_2$Re(n-C_6H_{13})H (8, 15%) and Cp(PMe_3)$_2$Re(c-C_5H_9)H (9, 17%) but only at less than -30°. Irradiation of 1 at 5-10°C in cyclohexane afforded cyclometalated product Cp(PMe_3)Re(eta^2-CH_2PMe_2)H (10, 31%) and Cp(PMe_3)$_2$Re(eta^1-CH_2PMe_2)H (11, 14%). 10 can dimerize to 16 and 17. The structure of 16 was determined by X-ray crystallography. Irradiation of 1, or thermolysis (20°C) of 10 in cyclohexane with methane gave Cp(PMe_3)$_2$Re(Me)H (12, 43%). Irradiation of 1 with ethylene in cyclohexane gave Cp(PMe_3)$_2$Re(CH=CH_2)H (14), which isomerized quantitatively to Cp-(PMe_3)$_2$Re(eta^2-(CH_2=CH_2)) (15, 45%) at 20°C in benzene. Irradiation of 15 regenerated 14, regardless of solvent. Thermolysis (20°C) of 8 with ethylene gave almost exclusively 14, thus ruling out 15 as the intermediate in the formation of 14. Isolation of compounds, 1, 5, 8, 10, 12, 15, and 16 in pure form required air-free chromatography at ca. -10°C. An efficient synthesis of Cp(PMe_3)$_2$$ReH_3$ (6, 71% from 3) is reported. Deprotonation of 6 followed by methylation afforded 12 (72%). All of the alkane C-H insertion products undergo facile reductive elimination of RH at room temperature.

46310 **Thermochemical comparisons of homogeneous and heterogeneous acids and bases. 1. Sulfonic acid solutions and resins as prototype Broensted acids.** Arnett, E.M.; Haaksma, R.A.; Chawla, B.; Healy, M.H. (Duke Univ., Durham, NC). *Journal of the American Chemical Society;* 108: No. 16, 4888-4896(6 Aug 1986). Contract FG22-82PC50807.

Heats of ionization by thermometric titration for a series of bases (or acids) can be used to compare solid acids (or bases) with liquid analogues bearing the same functionalities in homogeneous solutions. The method is demonstrated for Broensted acids by reacting a series of substituted nitrogen bases with solutions of p-toluenesulfonic acid (PTSA) in acetonitrile and with suspensions of the microporous polymeric arylsulfonic acid resin-Dowex 50W-X8 in the same solvent. Under well-controlled anhydrous conditions there is a good correlation (r = 0.992) between the heats of reaction of the bases with the homogeneous and heterogeneous acid systems, but the homogeneous system gives a more exothermic interaction by 3-4 kcal mol^{-1} for a series of 29 substituted pyrimidines, anilines, and some other amines. This difference may be attributed to homohydrogen bonding interactions between excess acid and sulfonate anion sites which are more restricted geometrically in the resin than in solution. Other factors which affect the enthalpy change for the acid-base interaction are the acid/base ratio, the water content of the sulfonic acid, the solvent, and the resin structure (e.g., microporous vs. macroporous). Steric hindrance in the base does not differentiate solid from homogeneous acid. In addition to the use of titration calorimetry, heats of immersion are reported for the Dowex-arylsulfonic acid resins and the Nafion-perfluorinated sulfonic acid resin in a series of basic liquids. The results are compared with each other and with those from a previous study of several varieties of coal.

46311 Preparation and characterization of radical cation salts derived from perfluorobenzene, perfluorotoluene, and perfluorophthalene. Richardson, T.J.; Tanzella, F.L.; Bartlett, N. (Univ. of California, Berkeley). *Journal of the American Chemical Society;* **108**: No. 16, 4937-4943(6 Aug 1986). Contract AC03-76SF00098.

The salts $C_6F_6^+AsF_6^-$, $C_6F_5CF_3^+AsF_6^-$, and $C_{10}F_8^+AsF_6^-$ may be prepared by electron oxidation of the appropriate perfluoro aromatic molecule with $O_2^+AsF_6^-$. Other O_2^+ salts can be similarly employed as can the more strongly oxidizing transition-metal hexafluorides, but salts of the latter are more labile than their AsF_6^- relatives. $C_6F_6^+AsF_6^-$ is a convenient electron oxidizer since that which remains from the reaction decomposes at room temperature to volatile products. Magnetic susceptibilities for $C_6F_6AsF_6$ and $C_{10}F_8AsF_6$ approximate to Curie law behavior, and g values are close to free-electron values. X-ray diffraction data (single crystal) show $C_6F_6AsF_6$ to be primitive rhombohedral with a_0 = 6.60 (1) A, α = 106.0 (1)°, V = 246.1 A³, Z = 1, probable space group R-3, and (powder data) $C_{10}F_8AsF_6$ to be tetragonal with a_0 = 8.27 (5) A, c_0 = 18.57 (s) A V = 1270 A, Z = 4. Salts derived from the monocyclic perfluoro aromatics are thermally unstable but can be kept below -15 °C. The perfluoronaphthalene salts are indefinitely stable at room temperatures. All hydrolyze rapidly. The products of thermal decomposition of the hexafluoroarsenates of the monocyclic cation salts parallel the products of the attack by F^-. The latter reaction products are in the molar ratios indicated by the following equations: $2C_6F_6^+ + 2F^- \rightarrow C_6F_6 + 1,4\text{-}C_6F_6$; $2C_6F_5CF_3^+ + 2F^- \rightarrow C_6F_5CF_3 + 1,3\text{-}C_6F{\rightarrow}CF_3$. The 1,3-$C_6F{\rightarrow}CF_3$ isomerizes to a 1:1 mixture with 1,4-$C_6F_7CF_3$.

46312 [4 + 4] dimerization of 2,3-dimethylene-2,3-dihydrofuran: secondary deuterium kinetic isotope effect evidence of a two-step mechanism. Chou, C.H.; Trahanovsky, W.S. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **108**: No. 14, 4138-4144(9 Jul 1986). Contract W-7405-ENG-82.

2,3-Dimethylene-2,3-dihydrofuran (1a), prepared by the flash vacuum pyrolysis of 2-methyl-3-furylmethyl benzoate (2a), rapidly dimerizes to form almost exclusively the [4 + 4] head-to-head dimer 3a. Rate constants k/sub a/, k/sub b/, k/sub c/, and k/sub d/ were measured at several temperatures for the dimerization, a [4 + 4] cycloaddition, of 1a, 2-methylene-3-dideuteriomethylene-2,3-dihydrofuran (1b), 2-dideuteriomethylene-3-methylene-2,3-dihydrofuran (1c), and 2-3-bis(dideuteriomethylene)-2,3-dihydrofuran (1d), respectively. At -30.0°C these rate constants in L $mol^{-1}s^{-1}$ were found to be k/sub /a = 6.223 +/- 0.458 x 10^{-4}, k/sub b/ = 1.147 +- 0.087 x 10^{-3}, k/sub c/ = 6.750 +- 0.602 x 10^{-4}, and k/sub d/ = 1.169 +- 0.086 x 10^{-3}, which indicates that k/sub a/ ~ k/sub c/ and k/sub b//k/sub a/ ≈ k/sub d//k/sub a/ = 1.86. It was found that the [4 + 4] dimerization rate of 1a is virtually the same in solvents ranging from 5:1 to 1:5 $CS_2/CDCl_3$, a result not consistent with the involvement of a zwitterionic intermediate. The secondary deuterium kinetic isotope effect results and the insignificant solvent effects lead to the conclusion that the [4 + 4] dimerization of 1a proceeds via a stepwise mechanism involving a diradical intermediate. The activation enthalpy, ΔH/sup double dagger/, for the 9 dimerization of 1a at 25°C is 10.2 +/- 0.3 kcal mol^{-1} and the activation entropy, ΔS/sup double dagger/, is -30.9 +/- 1.2 entropy units.

46313 Analytical conditions and data for cyclodextrin induced solid-surface room-temperature luminescence of selected compounds. Bello, J.M.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). *Analytical Letters;* **19**: No. 7-8, 775-796(1986). Contract AC02-80ER10624.

α-Cyclodextrin-NaCl mixtures studied as solid-surface substrates for inducing room-temperature phosphorescence (RTP) and fluorescence (RTF). The optimum conditions for inducing room-temperature luminescence were investigated extensively for four model compounds. Experimental conditions such as solvent, drying temperature, and surface atmosphere of the sample had a significant effect on luminescence signals. Furthermore, the analytical aspects of cyclodextrin induced solid-surface room-temperature luminescence (CISS-RTL) such as spectral characteristics, linear dynamic range, reproducibility of signal, and limits of detection were obtained. This is the first report of analytical figures of merit for the solid-surface luminescence of organic compounds mixed with α-cyclodextrin-NaCl.

46314 Use of a graph theoretic similarity index in prediction studies of linear discriminants and models. Jaeger, E.P.; Jurs, P.C. (Pennsylvania State Univ., University Park). pp 275-283 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A goal of many structure-activity and structure-property studies is to develop the capability to predict the activity or property of interest for previously untested compounds. A quantitative model or a discriminant is developed from a training set of molecules with known activities or properties. The best test of the predictive ability of a model or a discriminant is to predict the activities or properties of a set of unknown compounds, so the agreement between predicted and observed values can be judged. Unknown compounds which are structurally similar to those of the training set stand the best chance of being predicted accurately. Structural similarity can be assessed with atom pairs. The metric is based on the relative frequencies of all unique atom pairs in each compound being compared. The method can be used to compare two molecules, or it can be used to characterize a set of compounds, or it can be used to compare a few compounds (a prediction set) to a large collection of compounds (a training set). The characteristics of the atom pair similarity measure are discussed and examples of its use in the selection of prediction set members in several structure-activity and structure-property studies are shown.

46315 Vibronic activity probed by laser jet spectroscopy. Warren, J.A. Ames, IA; Iowa State Univ. (1985). 145p. University Microfilms Order No. 86-04,528.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Laser jet spectroscopy is applied to study the vibronic activity in β-methylnaphthalene and phenanthrene. Results of these studies indicate that the technique is invaluable in the determination of the mechanisms and spectral manifestations of vibronic coupling in large polyatomic species. In the S_1 state of β-methylnaphthalene, a Duschinsky rotation of normal coordinates results in extensive mode mixing as evidenced by highly structured single vibronic level (SVL) fluorescence spectra and drastic absorption/fluorescence mirror symmetry breakdown (MSB). The rotation is shown to be well modeled by simple first order perturbation formulae which readily reproduce the observed spectra. Additionally, anharmonicities to fourth order are apparent from the spectra of the molecule. In phenanthrene, absorption/fluorescence MSB is shown to be primarily the result of Condon/Herzberg-Teller transition moment interferences and model calculations again indicate that simple first order formulae can be used to reduce the observed spectra. While mode mixing does not appear to be important for totally symmetric modes of the molecule, vibronically induced transition of b_3 symmetry clearly indicate mixing from a Duschinsky rotation in these normal modes. Mixing as a result of Fermi resonances is also observed for some levels.

46316 Chemistry of berkelium. Peterson, J.R.; Hobart, D.E. (Univ. of Tennessee, Knoxville). *Advances in Inorganic Chemistry and Radiochemistry;* **28**: 29-72(1984). Contract AS05-76ER04447;W-7405-ENG-26;W-7405-ENG-36.

The possibility of studying the physical and chemical properties of Bk(II) in bulk is intriguing. It has been suggested that this new oxidation state of berkelium is produced by nature via the α decay of einsteinium-253 dihalides; however, in these absorption spectrophotometric studies, only the divalent parent species and the divalent californium-249 granddaughter species have been directly identified. Other work has shown that the β decay of berkelium-249 in the bulk-phase solid state results in the production of daughter californium-249 species exhibiting the same oxidation state and structural environment as those of the berkelium parent. Direct synthesis of Bk(II) via the reaction $Bk + 2BkBr_3 \rightarrow 3BkBr_2$ should be attempted to establish with certainty the existence of Bk(II) in the bulk-phase solid state and to characterize it via absorption spectrophotometry and X-ray powder diffraction. Studies of berkelium

metal under pressure should be continued to determine more precisely its bulk modulus and to search for the existence of a distorted face-centered cubic (fcc) modification between the known fcc and α-uranium-type orthorhombic phases. An interesting extension of this research would be to investigate the behavior of BkN under pressure to see if it might undergo a sudden volume collapse corresponding to a change in metallic valence from three to four. The preparation and characterization of intermetallic compounds and alloys of berkelium should be pursued, as well as the determination of the stability constants of Bk(IV) complexes. The range of oxidation states accessible to berkelium might be expanded by stabilizing Bk(II) and/or Bk(V) in highly complexing aqueous, nonaqueous, or even molten salt media and/or in appropriate solid-state matrices. 240 references, 9 figures, 5 tables.

46317 Highly stabilized radicals: benzylic radicals in polycyclic aromatic systems. McMillen, D.F.; Trevor, P.L.; Golden, D.M. (SRI International, Menlo Park, CA). *Journal of the American Chemical Society;* **102**: No. 24, 7400-7402(1980). Contract AC03-79ER10483.

Rates and equilibria of gas-phase benzylic bond scission for ethylbenzene, 1-ethylnaphthalene, and 9-ethylanthracene were measured. Enthalpies of formation of the highly stabilized arylmethyl radicals produced were determined, and the extent to which these values validate a recently developed technique for estimating resonance stabilization energies in polycyclic aromatic hydrocarbon radicals was evaluated. The very low-pressure pyrolysis (VLPP) technique was used. In this technique the reactor pressure is maintained low enough that reactive fragments formed in the initial bond-breaking step escape from the reactor to the mass spectrometric detection system before they undergo enough gas-gas collisions to result in secondary reactions of the starting material.

46318 (ORNL/tr—86/28) Condensation products of methyl chloro silane with dioxy-benzenes. Jacovic, M. Translated from *Zeitschrift fuer Anorganische und Allgemeine Chemie ;* **288**: 324-332(1956). Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013997.

We wished to investigate the entire series of possibilities that the combination of individual methyl chloro silanes with individual dioxy benzenes offers. The influence of the functional stage of the methyl chloro silanes, as well as the position of the OH groups in the nucleus, seemed to us to be of primary interest. The studies on the reactions between trimethyl chloro silane, dimethyl dichloro silane and methyl trichloro silane with pyrocatechin, resorcinol and hydroquinone were undertaken from this standpoint. Molecular weight determinations were also carried out on the said, previously produced, simply structured molecules. These studies revealed that in the case of the reaction between the monofunctional methyl chloro silane with any dioxy benzene and in the reaction between the difunctional methyl chloro silane with o-dioxy benzene relatively simply structured molecules are formed, but that the other cases complex molecules arise. 3 refs., 1 tab.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 46094

46319 Pressure dependence of the dielectric strength of SO_2 and n-C_4F_{10}. Nakanishi, K.; James, D.R.; Rodrigo, H.; Christophorou, L.G. (Oak Ridge National Lab., TN). *Journal of Physics, D (London). Applied Physics;* **17**: L73-L76(1984). Contract W-7405-ENG-26.

The dielectric strengths of sulphur dioxide (SO_2) and n-perfluorobutane (n-C_4F_{10}) have been investigated under DC voltages in uniform field geometries. The pressure range studied is between 3 and 265 kPa. The results show that the dielectric strength of both gases increases with the gas pressure, particularly in the pressure range below 100 kPa, even after allowing for the compressibility of the gases. An explanation of the phenomenon is discussed with reference to the pressure dependent electron attachment rate constant that has been measured in electron swarm experiments. 12 references, 2 figures.

4005 Photochemistry

REFER ALSO TO CITATION(S) 46246, 46247, 46290, 46301, 46309

46320 Temperature dependence of the lifetime of excited benzyl and other arymethyl radicals. Miesel, D.; Das, P.K.; Hug, G.L.; Bhattacharyya, K.; Fessenden, R.W. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **108**: No. 16, 4706-4710(6 Aug 1986). Contract W-31-109-ENG-38;AC02-76ER00038.

The temperature dependence of the fluorescence lifetime of benzyl, benzyl-d_7, α-methylbenzyl, and triphenylmethyl radicals has been studied in 2-methyltetrahydroduran from 77 to 300 K. Temperature independent and unusual temperature dependent relaxation pathways are observed for the excited states of all four radicals. Activation energies for the temperature-dependent relaxation process are ~1400 cm^{-1} for all these radicals, and frequency factors are in the range of (2-20) x 10^{11} s^{-1}. For Ph_3C radicals, the temperature-dependent process leads to observable photochemistry. However, no photochemistry is observed to result from the thermally activated relaxation of benzyl radicals. Possible pathways of these nonradiative decay processes are discussed and contrasted with the weak temperature dependence for the relaxation of diphenylmethyl radicals. It is proposed that the temperature-dependent route for the radiationless decay of benzyl radicals results from differential vibronic mixing of the two excited states, the 1^2A_2 and 2^2B_2 states. Most efficient in that mixing seems to be C-C stretching vibrational modes.

46321 Molecular beam photoionization spectrometry. (1) Photoionization studies of high temperature vapors. (2) State-selected and state-to-state studies of electron transfer reactions. Liao, C.L. Ames, IA; Iowa State Univ. (1985). 193p. University Microfilms Order No. 86-04,488.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Photoionization efficiency studies of high temperature vapors (S_2, Hg_2, HgKr, HgXe) have been performed using the supersonic oven beam method. These studies have yielded precise values of ionization energies of S_2, Hg_2, HgKr and HgXe and appearance energy for dissociative ionization. Dissociation energies of S_2, S_2^+, Hg_2^+, $HgKr^+$, and $HgXe^+$ and equilibrium bond distances of HgKr and HgXe have been calculated. Two Rydberg series converging to the $b^4\Sigma$/sub g/$^-$ state of S_2^+ have been observed. Window resonances resolved in the region of 650-850 A have been assigned as members of Rydberg series converging to the $c^4\Sigma$/sub u/$^-$ and ^{2}Pl/sub u/ (or $^2\Sigma$/sub u/$^-$) states of S_2^+, respectively. A new ion-neutral reaction apparatus, which combines high resolution spectrometry, crossed ion-neutral beam method and charge transfer detection, has been developed to examine the energy effects on the total charge transfer cross sections for the reaction $H_3^+(v_0') + H_2(v_0'' = 1) \rightarrow H_2(v') + H_3^+(v'')$. The vibrational state distribution of product $H_3^+(v'')$ ions in collision energy range of E/sub cm/ = 2-16 eV have been determined by the charge exchange method. A state-to-state study of fine-structure transitions in $Ar^+(^2P$/sub J/) + $Ar(^1S_0)$ charge transfer collisions have been performed. The spin-orbit effects on the charge transfer cross sections and kinetic energy dependences for the fine-structure transition probability (^2P/sub 3/2/ → ^2P/sub 1/2/ are in general agreement with the theoretical predictions.

46322 Photoemission study of the adsorption of benzotriazole on copper. Fang, B.S. Ames, IA; Iowa State Univ. (1985). 134p. University Microfilms Order No. 86-04,462.Contract W-7405-ENG-82.

Thesis (Ph. D.).

A photoemission study was performed on the chemisorption of benzotriazole (BTA) on polycrystalline copper (clean and oxidized) surfaces to understand the corrosion inhibition mechanism. The energy distribution curves indicate benzotriazole bonding to copper through nitrogen lone pair orbitals. They also disagree with the models which suggest that the benzotriazole molecular plane is oriented parallel to the copper surface by showing a lack of π-d interaction. The observed chemisorption of benzotriazole on atomically clean copper surfaces at room temperature suggests that an

oxide layer is not necessary for the adsorption of benzotriazole. No structural difference was observed in the photoemission studies on BTA-clean copper and BTA-cuprous oxide surface film. This result demonstrates the major role of the copper atom upon benzotriazole adsorption. A new model of the CuBTA chemisorbed structure is presented. The Cu-BTA polymer is formed by strong charge-transfer interactions between benzotriazole molecules instead of by BTA-Cu-BTA connections. It successfully interprets the experimental results from solubility and tarnish resistance tests on adsorbed films on copper surfaces. It also gives a reasonable explanation for the different inhibition coefficients among BTA-treated copper single crystal surfaces. Mechanisms are suggested for the benzotriazole inhibition mechanisms.

46323 **Photochemical properties of rhodium(III) phthalocyanine cation radicals.** Ferraudi, G.; Oishi, S.; Muraldiharan, S. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **88**: No. 22, 5261-5264(1984).

Stable rhodium(III) phthalocyanine cation radicals, Rh(pc)$(CH_3OH)X^+$ with X = Cl or Br, were generated by one-electron chemical or electrochemical oxidations of the corresponding rhodium(III) phthalocyanines, Rh(pc) $(CH_3OH)X$, and characterized by means of their EPR and optical spectra. Some transitions in the optical spectra of the radicals were assigned by comparison with similar transitions in the spectra of the parent phthalocyanines. Moreover, the photochemical properties of the radicals were investigated by continuous, laser, and flash photolysis. Irradiations in the UV bands, λ/sub excit/ = 250 or 320 nm, induce the photoreduction of the radicals (back to the parent phthalocyanine) by abstraction of hydrogen. Photolysis in the visible region, λ/sub excit/ = 525 nm, induces the photodecomposition of the macrocycle. The mechanisms of these photoprocesses are discussed by comparison with known photochemical transformations of related compounds. 28 references, 3 figures, 1 table.

46324 **Two-frequency CO_2 laser multiple-photon dissociation and dynamics of excited state absorption in CDF_3.** Herman, I.P. (Lawrence Livermore National Lab., CA). *Chemical Physics (Amsterdam);* **75**: 121-132(1983). Contract W-7405-ENG-48.

The two-frequency multiple-photon dissociation probability in CDF_3 is studied as a function of wavelength, fluence and pulse separation using two pulsed CO_2 lasers. When the nu_5 mode of CDF_3 is excited by an R(12), 10.3 μ prepulse, the probability for subsequent dissociation is approximately constant from 940 to at least 990 cm^{-1}. A model of excited state absorption in CDF_3 is presented to help explain these results. Implications for deuterium separation are also discussed. 27 references, 11 figures, 1 table.

4006 Radiation Chemistry

46325 **Investigation of OH dynamics in the argon sensitized pulse radiolysis of water vapor.** Bera, R.K.; Hanrahan, R.J. (Department of Chemistry, University of Florida, Gainesville, Florida 32611). *Journal of Applied Physics;* **60**: No. 6, 2115-2122(15 Sep 1986).

Reactions of OH radical were studied in systems containing 650-Torr Ar and from 0.5 to 9-Torr H_2O using the method of pulse radiolysis-absorption spectroscopy. It was found that initial concentrations of OH radical increased and the half-life for its loss decreased at higher water pressures. Dependence of OH half-life on OH concentrations occurs because homogeneous OH loss processes are second order in reaction intermediates, whose concentration increases with added H_2O. A contribution by water in chaperoning OH/OH and OH/H combination is also important. The kinetic scheme was examined with a Gear integrator. A good fit of the experimental rate data was obtained using literature values for rate constants of OH+OH, OH+H, and H+H reactions, when experimental zero-time absorbance values were converted to OH concentrations based on an extinction coefficient of 6.37×10^4 l mol^{-1} cm^{-1} at 309.5 nm. Using the same extinction coefficient, an alternative empirical reduction of rate data gives k-italic (apparent bimolecular) for loss of OH at 650-Torr Ar pressure of 5.06×10^{-11} cm^3 $molec^{-1}$ s^{-1}, consistent with literature rate constants within 10%. Dependence of OH yield on water concentration is interpreted on a two state model for argon precursor, involving short-lived (resonance state) Ar^* (^{1}P-italic$_1$ and ^{3}P-italic$_1$) and longer-lived (metastable) Ar^{**} (^{3}P-italic$_2$ and ^{3}P-italic$_0$). Adjustment of assumed initial Ar^* and Ar^{**} concentrations allowed prediction of measured OH concentrations within experimental error at all water pressures studied.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 46245, 46292

46326 **(PNL—5948) List of DOE radioisotope customers with summary of radioisotope shipments, FY 1985.** Baker, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 51p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014817.

This document describes radioisotope distribution from DOE facilities to private firms including foreign and other DOE facilities. The information is divided into five sections: (1) isotope suppliers, facility contacts, and isotopes or services supplied; (2) customers, suppliers, and isotopes purchased; (3) isotopes purchased cross-referenced with customer numbers; (4) geographic locations of radioisotope customers; and (5) radioisotope sales and transfer - FY 1985.

46327 **Radiation-induced redox specification of sup(77)Br in aqueous solution as determined by anion chromatography.** Wanek, P.M.; Grant, P.M. (Los Alamos National Lab., NM, USA). *Journal of Radioanalytical and Nuclear Chemistry;* **99**: No. 1, 187-192(May 1986).

sup(77)Br is of potential use in diagnostic nuclear medicine as the parent of ultrashort-lived sup(77m)Se in a radioisotopic generator systems. The chemical forms(s) of the radiobromine in aqueous solution, and their radiation-induced chemical transformations, are of importance for biomedical generator development. Approximately 150 mCi of radiobromine, initially present as Brsup(-) was studied over a period of three weeks and analyzed for BrOsub(x)sup(-) (x=0-4) by anion exchange chromatography. Radiolysis of the solution gave rise to a small quantity of BrOsub(3)sup(-), but 99.5% of the activity remained as bromide. 15 refs.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 46317, 46414

46328 **(N—86-24961) Characterization of simulated small-droplet fuel sprays.** Ingebo, R.D. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. 10p. (NASA-TM—87286; E—2987; CONF-8606184—1). NTIS, PC A02/MF A01.

From 22. joint propulsion conference; Huntsville, AL, USA (16 Jun 1986).

A two-fluid pneumatic atomizer operating at relatively high liquid and gas pressures produced water sprays that simulated small-droplet clouds of liquid fuel for use in studying vaporization and fuel-air mixing effects on combustor performance and emissions. To characterize the sprays, a scattered-light scanning instrument was developed and measurements of volume median or volume mean diameter, D sub V.5, were correlated with D sub O, W sub w, and W sub n, i.e., orifice diameter, water, and nitrogen gas flow rates, respectively, to give the general expression: D sub v.5 approx. (D sub o sup 0.2) (W sub w sup m) (W sub n sup n), which yields D sub v.5 = 45 (D sub o sup 0.2) (W sub w sup 0.2) (W sub w sup - 1.2). Values of D sub o, W sub w, and W sub n are in centimeters and grams/second, respectively. Farther downstream at an axial distance of 6.7 cm, exponent m increased from 0.2 to 0.4 and exponent n decreased from -1.2 to -1.0 and at a distance of 25 cm downstream of the atomizer, n decreased to -0.8. The increase in exponent m and decrease in exponent n was attributed to a loss of very small droplets from the spray due primarily to vaporization and diffusion effects on clouds of small droplets traveling a distance of 25 cm.

46329 (N—86-25429) Mass spectrometric gas composition measurements associated with jet interaction tests in a high-enthalpy wind tunnel. Lewis, B.W.; Brown, K.G.; Wood, G.M.,JR.; Puster, R.L.; Paulin, P.A.; Fishel, C.E.; Ellerbe, D.A. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Jun 1986. 33p. (NASA-TM—87642; L—16074). NTIS, PC A03/MF A01.

Knowledge of test gas composition is important in wind-tunnel experiments measuring aerothermodynamic interactions. This paper describes measurements made by sampling the top of the test section during runs of the Langley 7-Inch High-Temperature Tunnel. The tests were conducted to determine the mixing of gas injected from a flat-plate model into a combustion-heated hypervelocity test stream and to monitor the CO_2 produced in the combustion. The Mass Spectrometric (MS) measurements yield the mole fraction of N_2 or He and CO_2 reaching the sample inlets. The data obtained for several tunnel run conditions are related to the pressures measured in the tunnel test section and at the MS ionizer inlet. The apparent distributions of injected gas species and tunnel gas (CO_2) are discussed relative to the sampling techniques. The measurements provided significant real-time data for the distribution of injected gases in the test section. The jet N_2 diffused readily from the test stream, but the jet He was mostly entrained. The amounts of CO_2 and Ar diffusing upward in the test section for several run conditions indicated the variability of the combustion-gas test-stream composition.

46330 (N—86-25431) Ignition delay times of benzene and toluene with oxygen in argon mixtures. Burcat, A.; Snyder, C.; Brabbs, T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1985. 15p. (NASA-TM—87312; E—3041). NTIS, PC A02/MF A01.

The ignition delay times of benzene and toluene with oxygen diluted in argon were investigated over a wide range of conditions. For benzene the concentration ranges were 0.42 to 1.69 percent fuel and 3.78 to 20.3 percent oxygen. The temperature range was 1212 to 1748 K and the reflected shock pressures were 1.7 to 7.89 atm. Statistical evaluation of the benzene experiments provided an overall equation which is given. For toluene the concentration ranges were 0.5 to 1.5 percent fuel and 4.48 to 13.45 percent oxygen. The temperature range was 1339 to 1797 K and the reflected shock pressures were 1.95 to 8.85 atm. The overall ignition delay equation for toluene after a statistical evaluation is also given. Detailed experimental information is provided.

46331 (UCRL—94731) Solid combustion processes for improved synthesis of non-oxide materials. Holt, J.B. (Lawrence Livermore National Lab., CA (USA)). 13 Jun 1986. Contract W-7405-ENG-48. 8p. (CONF-860893—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014434.

From International symposium on fundamental research strategy in the development of new materials for efficient energy conversion; Osaka, Japan (25 Aug 1986).

Combustion Synthesis takes advantage of the heat evolved during the chemical reaction between mixtures of solids or solids and gases. The quantity of heat released varies widely according to the particular chemical system. If the reaction is carried out in the combustion mode, then the product is raised to a high temperature by a rapidly moving combustion wave. This simple concept is the basis of a new low-cost approach to the synthesis of many refractory materials. The unique characteristics of this combustion process are the high temperatures (2000 to 3500°C) that are generated without the use of external energy, the rapidly moving combustion wave (0.1 to 10 cm/s), the high rate of heating at the combustion front (10^4 to 10^6 °C/s) and volatilization of cation impurities at the combustion front. Our research clearly demonstrates that the Solid Combustion Process has potential as a method to synthesize many high-quality refractory materials by cost-effective methods.

46332 Symposium (International) on Combustion, 20th, University of Michigan, Ann Arbor, MI, August 12-17, 1984, Proceedings. Pittsburgh, PA; Combustion Institute (1985). 2235p. (CONF-840801—).

From 20. international symposium on combustion; Ann Arbor, MI, USA (12 Aug 1984).

The present conference on combustion phenomena considers topics in automotive engine combustion, turbulent reacting flows, the modeling of practical combustion systems, reaction kinetics, combustion-generated particulates, combustion diagnostics, coal combustion process characteristics, fire-related phenomena, explosion/detonation phenomena, spray combustion, ignition/extinction, laminar flames, pollutant formation processes, practical combustor devices, and rocket propellant combustion. Attention is given to the contributions of combustion science to piston engine design, modeling and measurement techniques for turbulent combustion, the specific effects of energy, collisions, and transport processes in combustion chemistry kinetics, the formation of large molecules, particulates and ions in premixed hydrocarbon flames, the application of laser diagnostics to combustion systems, spark ignition energies for dust-air mixtures, the controlling mechanisms of flow-assisted flame spread, the ignition and combustion of coal-water slurries, spontaneous ignition of methane, turbulent and accelerating dust flames, and the temperature sensitivity of double base propellants.

46333 Measurements of superequilibrium hydroxyl concentrations in turbulent nonpremixed flames using saturated fluorescence. Drake, M.C.; Pitz, R.W.; Lapp, M.; Fenimore, C.P.; Lucht, R.P. (General Electric Co., Schenectady, NY; Purdue Univ., West Lafayette, IN). pp 327-335 of Symposium (International) on Combustion, 20th, University of Michigan, Ann Arbor, MI, August 12-17, 1984, Proceedings. Pittsburgh, PA; Combustion Institute (1985). (CONF-840801—).

From 20. international symposium on combustion; Ann Arbor, MI, USA (12 Aug 1984).

The first quantitative, time- and space-resolved measurements have been obtained for probability density functions of OH concentration in nonpremixed flames. Measurements using single-pulse, laser-saturated fluorescence in laminar, transitional, and turbulent nonpremixed H2-air flames provide unambiguous evidence for substantial OH superequilibrium concentrations, in qualitative agreement with predictions of laminar and turbulent combustion models. The average degree of superequilibrium, OH/OH(AE), is typically 4-5 near the jet exit and approaches unity far downstream. The maximum instantaneous OH concentration measured in transitional and turbulent H2-air flames is about 6 x 10 to the 16th molecules/cc, in accord with the maximum determined by partial equilibrium thermodynamic calculations and with the maximum OH concentrations measured in premixed H2-air flames. 29 references.

46334 Variational transition state theory and tunneling calculations of potential energy surface effects on the reaction of $O(^3P)$ with H_2. Truhlar, D.G.; Runge, K.; Garrett, B.C. (Univ. of Minnesota, Minneapolis). *Symposium (International) on Combustion, [Proceedings]*; 585-594(1984). Contract AC02-79ER10425.

Variational transition state theory with adiabatic and least-action ground-state transmission coefficients is applied to calculate reaction rates for $O(^3P) + H_2 \rightarrow OH + H$ in both collinear and three-dimensional worlds for temperatures of 200-1400 K. Five different potential energy surfaces are considered. The collinear studies are used to assess the accuracy of the dynamical and energetic approximations, which include the no-recrossing assumption of generalized transition state theory, semiclassical methods for tunneling calculations, and a Morse approximation for quantizing the generalized-transition-state stretching vibrations. Although the potential energy surfaces show wide differences in behavior, the calculations with least-action ground-state transmission coefficients agree with the accurate quantal results within a factor of 2.8 in all cases. The authors find that the three-dimensional reaction is dominated by tunneling at room temperature and nearby for all five surfaces. For the calculations on the most accurate ab initio potential energy surface, 60% of the ground-state reaction proceeds by tunneling even at 400 K. The tunneling fractions rise dramatically as the temperature is lowered. The calculations show that the quantitative estimation of the tunneling effects requires consideration of reaction-path curvature and of tunneling paths that deviate from the minimum energy path. 34 references, 4 figures, 3 tables.

46335 **High-temperature oxidation of H_2 on a platinum catalyst.** Brown, N.J.; Schefer, R.W.; Robben, F. (Lawrence Berkeley Lab., CA). *Combustion and Flame;* 51: 263-277(1983). Contract W-7405-ENG-48.

The high-temperature surface oxidation of H_2 on a platinum catalyst in the presence of excess air has been studied over a range of surface temperatures from 450 to 1070K and equivalence ratios from 0.05 to 0.20. the objectives were (1) to develop a system in which the surface kinetics of various fuel-air mixtures can be studied under conditions of interest to catalytic combustion and (2) to determine the high-temperature surface oxidation rate for lean H_2/air mixtures on a platinum catalyst. The experimental system considered was the laminar boundary layer of a heated catalytic plate. Under all conditions investigated the surface reaction rapidly became diffusion limited downstream of the plate leading edge. A finite difference scheme was utilized to model numerically the flow field above the plate surface. This enabled surface reaction rate data to be obtained under those conditions where surface reaction rates were significantly influenced by transport effects. Based on a one-step model for H_2 oxidation the data were found to correlate well with a reaction rate expression of the form R/sub s/ = 1.4 x 10^3[H_2]/sub s/ exp(-3850/RT) (mole/cm^{2}s). The effects of heat and mass transfer on the kinetics are also discussed. 18 references, 10 figures.

42 ENGINEERING

4201 General Engineering

REFER ALSO TO CITATION(S) 46383

46336 **(UCRL—94092) Silicon diffraction gratings for multilayer structures.** Ciarlo, D.R.; Miller, D.E. (Lawrence Livermore National Lab., CA (USA)). 20 Jun 1986. Contract W-7405-ENG-48. 11p. NTIS, PC A02. File Number DE86014446.

Anisotropic etching was used to fabricate diffraction gratings on silicon wafers for use as substrates for layered synthetic multilayers. We worked with (110 and (100) oriented wafers to achieve etched sidewall angles of 35.3°, 46.5°, 54.7°, and 90°. Contact lithography was used to print grating with a 20μ period in order to evaluated the quality of the etched sidewalls. Projections lithography was used to print grating with a 2μ period. Blazed grating were fabricated from (111) oriented wafers cut 6° off the normal to the growth direction. a crystal alignment techniques is described that allowed us to align the gratings to better than 0.1° of the correct crystal direction. Measurements are reported on the smoothness of etched silicon surfaces using three different etches.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 45631, 45711, 46198, 46407, 47110

46337 **(LA-UR—86-1076) Analysis of magnetic refrigerators with external regeneration.** Overton, W.C. Jr.; Barclay, J.A. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 8p. (CONF-860962—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86008757.

From International Institute of Refrigeration (CRYOPRAGUE); Prague, Czechoslovakia (8 Sep 1986).

The central idea of the magnetic refrigeration systems analyzed in this paper is that of a MR having a regenerator composed of an integral number of separate stages but having only a single magnetic stage. In principle, each stage is thermally isolated from the others, but the stages are accessed by a manifold and valve system which allows gas to flow between the MM and the individual stages. The concept therefore is distinctly unlike that of the unusual continuous regenerator of gas refrigerators. Although a small amount of gas in the manifold is responsible for the actual transfer of heat between elements of the REGMR, it is clear from the cycle description in the caption of Fig. 1 that the fixed mass of the MM is analogous to a fixed mass of a working fluid in a gas refrigerator or engine. Both, in effect, are carried thermally through all parts of their respective systems.

46338 **(LA-UR—86-2352) Rail guns driven by helical flux compression generators.** Fowler, C.M.; Zimmermann, E.L.; Cummings, C.E.; Davidson, R.F.; Foley, E.; Fox, W.E.; Kerrisk, J.F.; Parker, J.V.; Parson, W.M.; Schnurr, N.M. (Los Alamos National Lab., NM (USA); IAP Research, Inc., Dayton, OH (USA)). 1986. Contract W-7405-ENG-36. 8p. (CONF-860703—13). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013853.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

Explosively-driven helical flux compression generators are generally of larger inductance and therefore of higher energy gain than most other flux compression generators. On the other hand the operation times (usually 200 to 300 μs or less) are usually too short to serve as direct power supplies for most rail gun applications. This limitation is circumvented, however, when the generator is used to charge an inductive storage coil, which then serves as the rail-gun energy source. We describe here the results of several recent tests with such systems. Projectile masses have ranged from 0.6 to 1.0 kg; both plasma and solid armature modes have been employed. The flux compression generator and its characteristics are describeed, together with the storage coil, the rail gun, projectiles and diagnostics employed. Particular attention is devoted to minimizing flux losses, for example, in the design of the storage coil input crowbar which is activated after the coil is loaded by the generator.

46339 **(LA-UR—86-2371) Conceptual design for a short-pulse explosive-driven generator.** Caird, R.S.; Fowler, C.M. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 8p. (CONF-860703—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013851.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

A design is described for a short-pulse explosive-driven generator. The initial flux is provided by a side-fed one-turn coil that is crow-barred at peak field. This field is then compressed by the axially uniform expansion of a cylindrical armature inside the coil. A multistrand helical coil is used to convert the changing flux to voltage at the coaxial output. The circuit is completed by the impact of the armsture against contact rings connected to the helical coil and output. An approximate circuit model is derived. The analysis indicates that several megajoules can be delivered to an inductive load in 0.5 to 5.0 μs.

46340 **(LA-UR—86-2378) Experiments with multi-megampere explosively formed fuses in cylindrical geometry.** Goforth, J.H.; Marsh, S.P.; Lindemuth, I.; Kruse, H.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-860703—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013848.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

Taking advantage of the high energy density attainable in the magnetic field of an inductor requires a prime power source capable of producing very large currents and a means of extracting the energy as a fast current pulse from the inductive store. Many existing high current sources have pulse risetimes of hundreds of microseconds, while most pulsed power applications have submicrosecond pulse requirements. In principle, high current opening switches represent a good solution to the problem. An inductor is charged over a long period of time by a relatively slow current supply with a closed switch completing the circuit. At a desired time, the switch is opened and the voltage produced transfers current rapidly to a load circuit. In practice, building opening switches that will carry multimegampere currents for hundreds of microseconds and then open on a submicrosecond time scale has posed an extremely difficult problem. Explosive-driven opening switches have been used in long-pulse applications for some time, but until recently the explosives systems used to drive these devices would not produce a rapidly opening switch. We have developed a fast technique for interrupting large currents by using explosives to extrude short sections of relatively thick conductors into long thin

fuse-like conductors. Although the formation of the fuse requires about 2 μs, the switch will sustain considerable voltage as its resistance rises, and it is feasible to deliver pulses with ~ 1 μs risetimes to low inductance loads. We discuss here the small scale proof of principle experiments and 2-D hydrodynamics calculations that have led to an optimized cylindrical opening switch design. In addition, we will describe the results of testing a cylindrical switch at currents up to 4.6 MA, and give extrapolations for device designs for the 15 to 20 megampere range.

46341 **(LA-UR—86-2507) Testing of the Mark 101 magnetic flux compression generator.** Freeman, B.L.; Fowler, C.M.; King, J.C.; Martinez, A.R. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860703—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013833.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

The Mark 101 explosive flux compression generator is a line-initiated, vacuum/magnetically insulated, helical generator. This device offered some unique challenges in transforming the theoretical design into a testable experiment. The two main reasons for this are that in theory an eight-turn, four-wire Mark 101 possesses a terminal dL/dt of ~0.5 Ω and operates with electric fields which are greater than the threshold for electron field emission. With this in mind, we designed an integral vacuum-jacket-generator configuration with a passive load inductance of ≦0.5 μH. The generator contained ~8 μH of initial inductance. The field emission required the stator to be entirely sealed within the vacuum jacket. The open, helical stator resulted in the presence of non-trivial leakage fields and voltages. To accommodate these fields, the vacuum chamber for the generator was segmented and axially insulated with rings of acrylic, similar to stacked-ring diodes. We made no attempt to break the azimuthal metal surfaces due to the physical difficulty this would incur. Diagnostics included an input current Rogowski loop, a load Rogowski loop, two dB/dt probes in the load, a Faraday fiber-optic current sensor, and two dB/dt probes in the region between the stator winding and the vacuum jacket to measure the leakage azimuthal and axial magnetic fields. The results of explosive tests are presented.

46342 **(N—86-25305) Thermal performance evaluation of the infrared telescope dewar subsystem.** Urban, E.W. (National Aeronautics and Space Administration, Huntsville, AL (USA). George C. Marshall Space Flight Center). Apr 1986. 127p. (NASA-TM—86543). NTIS, PC A07/MF A01.

Thermal performance evaluations (TPE) were conducted with the superfluid helium dewar of the Infrared Telescope (IRT) experiment from November 1981 to August 1982. Test included measuring key operating parameters, simulating operations with an attached instrument cryostat and validating servicing, operating and safety procedures. Test activities and results are summarized. All objectives are satisfied except for those involving transfer of low pressure liquid helium (LHe) from a supply dewar into the dewar subsystem. 1 reference.

46343 **(NE-F—3-42-7-86) Operating policy of DOE filter test program. Revision.** (Oak Ridge National Lab., TN (USA)). 31 Jul 1986. Contract AC05-84OR21400. 9p. N.S.M.C., Box Y, Oak Ridge, TN 37831. File Number TI86013424.

This standard establishes policies and procedures for the operation of the US Department of Energy (DOE) Filter Test Facilities (FTF) at Oak Ridge, Tennessee; Golden, Colorado; and Richland, Washington. This standard also establishes DOE-wide HEPA filter procurement, HEPA filter testing, and to the degree stated, respirator canister testing policies.

46344 **(NE-F—3-43-7-86) Quality assurance testing of HEPA filters. Revision.** (Oak Ridge National Lab., TN (USA)). 31 Jul 1986. Contract AC05-84OR21400. 33p. Nuclear Standards Management Center, Box Y, Oak Ridge, TN 37831. File Number TI86013422.

This standard covers requirements for the quality assurance inspection and testing of HEPA filters and respirator canisters by the US Department of Energy (DOE) Filter Test Facilities (FTFs) at Oak Ridge, Tennessee; Golden, Colorado; and Richland, Washington. The standard implements the policies established in NE F 3-42, "Operating Policy of DOE Filter Test Programs," and provides a basis for the preparation of written procedures for conducting primary FTF functions. As noted in NE F 3-42, Sec. 4, these standards apply only to filters used at DOE installations for health or environmental protection purposes. These filters are described as "Type B" filters in Institute of Environmental Sciences, IES RP-CC-001-86, "Recommended Practices for HEPA Filters."

46345 **(NE-F—3-44-7-86) DOE filter test facilities quality program plan. Revision.** (Oak Ridge National Lab., TN (USA)). 25 Jul 1986. Contract AC05-84OR21400. 7p. N.S.M.C., Box Y, Oak Ridge, TN 37831. File Number TI86013388.

This standard covers requirements for the quality assurance inspection and testing HEPA filters and DOE filter test facilities.

46346 **(ORNL/TM—9889) Summary of the technical review of the safety analysis reports for packaging (SARP) for the transnuclear transport/storage casks: TN-BRP and TN-REG.** (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 137p. NTIS, PC A07/MF A01; GPO Dep. File Number DE86014394.

The Safety Analysis Reports for Packaging for two spent fuel shipping casks were technically reviewed by the Oak Ridge National Laboratory. The casks were designed by Transnuclear, Inc., for shipment of 85 Big Rock Point boiling water reactor fuel elements and 40 R.E. Ginna pressurized water reactor fuel elements from West Valley, New York, to Idaho Falls, Idaho. The intent of the review was to ensure compliance of the casks with the requirements the applicable Federal Regulations contained in 10 CFR Pt. 71 and allow issuance of Department of Energy Certificates of Compliance for transport by the Department of Energy Idaho Operations Office. The review was performed by a team of Oak Ridge National Laboratory staff assembled for their expertise in criticality analysis, shielding, metallurgy, nondestructive testing, thermal analysis, structural analysis, and containment. This report describes the review processes, the findings in each technical area, and the overall conclusion that a Certificate of Compliance could be issued for the proposed single shipment under the specified conditions and constraints.

46347 (ORNL/TM—9923, pp 17-34) **Multiple levels of representation and problem-solving using maps from sonar data.** Elfes, A. (Carnegie-Mellon Univ., Pittsburgh, PA). Jan 1986. NTIS, PC A09/MF A01. File Number DE86006813. (CONF-8508163—).

From 2. DOE/CESAR workshop on planning and sensing for autonomous navigation; Los Angeles, CA, USA (18 Aug 1985).

A sonar-based mapping and navigation system for autonomous mobile robots operating in unknown and unstructured surroundings is described. The system uses sonar range data to build a multi-leveled and multi-faceted description of the robot's operating environment. Sonar maps are represented in the system along several dimensions: the Abstraction axis, the Geographical axis, and the Resolution axis. Different kinds of problem-solving activities can be performed and different levels of performance can be achieved by working with these multiple representations of maps. The major modules of the Dolphin system are described and related to the various mapping representation used. The system is also situated within the wider context of developing an advanced software architecture for autonomous mobile robots.

46348 (ORNL/TM—9923, pp 35-60) **Synthesis of digital machines with provable epistemic properties.** Rosenschein, S.J.; Kaelbling, L.P. (SRI International, Menlo Park, CA). Jan 1986. NTIS, PC A09/MF A01. File Number DE86006813. (CONF-8508163—).

From 2. DOE/CESAR workshop on planning and sensing for autonomous navigation; Los Angeles, CA, USA (18 Aug 1985).

Many artificial intelligence applications involve the design of systems intended to track and react to conditions in their physical environments in real time. Real-time performance is difficult to

achieve using traditional AI techniques because of their reliance on expensive runtime symbolic inference. This problem is addressed by describing a mathematical framework and design tools for analyzing and synthesizing machines with compiled knowledge. The concept of knowledge is formulated mathematically in terms of the relationship between states of a machine and states of its environment over time. The design approach is based on the use of metaprograms to compute a machine description which can then be transformed either into physical circuitry or into code that simulates the described machine. The compilation of knowledge is facilitated by parameterizing machine constructors by other machine constructors and by objects usually encoded as runtime structures.

46349 (ORNL/TM—9923, pp 61-83) **Intelligent machine operating system for hypercube ensemble architectures.** Barhen, J. (Oak Ridge National Lab., TN). Jan 1986. NTIS, PC A09/MF A01. File Number DE86006813. (CONF-8508163—).

From 2. DOE/CESAR workshop on planning and sensing for autonomous navigation; Los Angeles, CA, USA (18 Aug 1985).

The research involving the development of dynamic resource allocation (scheduling and load-balancing) algorithms in a virtual time environment is described. These algorithms will be embedded into a virtual time intelligent machine operating system. The emphasis is on applications characterized by structures irregular in time and space, with irregularities unpredictable in advance, and which might be as often communication-bound as compute-bound. Since the ultimate objective is to exploit advanced computer architectures for machine intelligence problems, the generic IMOS/VT methodology is targeted at a wide spectrum of concurrent computation requirements, extending from coarse-grain architectures to fine-grain connection-machine-type systems. The current implementation framework focuses on hypercube ensembles.

46350 (ORNL/TM—9923, pp 85-93) **Planning for transit in unknown natural terrain.** Harmon, S.Y. (Naval Ocean Systems Center, San Diego, CA). Jan 1986. NTIS, PC A09/MF A01. File Number DE86006813. (CONF-8508163—).

From 2. DOE/CESAR workshop on planning and sensing for autonomous navigation; Los Angeles, CA, USA (18 Aug 1985).

The Ground Surveillance robot (GSR) development has reached a stage where a route planning system is potentially useful. The GSR's route planning problem can be solved by having a generalized planning engine operate upon a data base containing orienteering knowledge and models of the vehicle and the surrounding environment. Orienteering knowledge contains heuristics for position finding, route planning and route following in undeveloped terrain. Some orienteering hints valuable to an autonomous vehicle planning transit through unknown undeveloped territory are discussed. In addition, the requirements for a sufficient planning mechanism to support autonomous for a sufficient planning mechanism to support autonomous transit through unknown natural terrain are also discussed.

46351 (ORNL/TM—9923, pp 95-120) **O-theory - a hybrid uncertainty theory.** Oblow, E.M. Jan 1986. NTIS, PC A09/MF A01. File Number DE86006813. (CONF-8508163—).

From 2. DOE/CESAR workshop on planning and sensing for autonomous navigation; Los Angeles, CA, USA (18 Aug 1985).

A hybrid uncertainty theory is developed to bridge the gap between fuzzy set theory and Bayesian inference theory. Its basis is the Dempster-Shafer formalism (a probability-like, set-theoretic approach), which is extended and expanded upon so as to include a complete set of basic operations for manipulating uncertainties in approximate reasoning. The new theory, operator-belief theory (OT), retains the probabilistic flavor of Bayesian inference but includes the potential for defining a wider range of operators like those found in fuzzy set theory. The basic operations defined for OT include those for: dominance and order, union, intersection, complement and general mappings. A formal relationship between the membership function in fuzzy set theory and the upper probability function in fuzzy set theory and the upper probability function in the Dempster-Shafer formalism is also developed. Several sample problems in logical inference are worked out to illustrate the results derived from this new approach as well as to compare them with the other theories currently being used. A general method of extending the theory using the historical development of fuzzy set theory as an example is suggested.

46352 (UCRL—94446) **Summary of railgun development for ultrahigh-pressure research.** Hawke, R.S.; Nellis, W.J.; Newman, G.H.; Rego, J.; Susoeff, A.R. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 9p. (CONF-860703—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013021.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

This paper summarizes the results of EM launcher tests performed at Lawrence Livermore National Laboratory. The system used a helium gas injector and railgun launcher to accelerate and launch 1- and 4-g polycarbonate projectiles intact up to 6.6 and 3.0 km/s, respectively. A 625 kJ capacitor bank powered the railgun, and an adjustable inductor provided pulse shaping and peak current control. Operation in hard and soft vacuum was reliably achieved. Projectiles were accelerated without blowby and were verified by flash x-ray shadowgraphs to be intact after launch. A precision-bore launcher and projectiles with flared gas seals were used. Although injection at 1 km/s significantly reduced erosion, it did not eliminate it. 5 refs., 12 figs., 4 tabs.

46353 **Focusing corner cube.** Monjes, J.A. (to Dept. of Energy). US Patent Application 6-775,546. 12 Sep 1985. 13p. Contract W-7405-ENG-48. DE86013762 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013762.

This invention retortreflects and focuses a beam of light. The invention comprises a modified corner cube reflector wherein one reflective surface is planar, a second reflective surface is spherical, and the third reflective surface may be planar or convex cylindrical.

46354 **In situ repair of a failed compression fitting.** Wolbert, R.R.; Jandrasits, W.G. (to Dept. of Energy). US Patent Application 6-762,489. 5 Aug 1985. 14p. Contract AC11-76PN00014. DE86013682 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013682.

A method and apparatus for the in situ repair of a failed compression fitting is provided. Initially, a portion of a guide tube is inserted coaxially in the bore of the compression fitting and locked therein. A close fit dethreading device is then coaxially mounted on the guide tube to cut the threads from the fitting. Thereafter, the dethreading device and guide tube are removed and a new fitting is inserted onto the dethreaded fitting with the body of the new fitting overlaying the dethreaded portion. Finally, the main body of the new fitting is welded to the main body of the old fitting whereby a new threaded portion of the replacement fitting is precisely coaxial with the old threaded portion. If needed, a bushing is located on the dethreaded portion which is sized to fit snugly between the dethreaded portion and the new fitting. Preferably, the dethreading device includes a cutting tool which is moved incrementally in a radial direction whereby the threads are cut from the threaded portion of the failed fitting in increments.

46355 **Low voltage arc formation in railguns.** Hawke, R.S. (to Dept. of Energy). US Patent Application 6-762,649. 5 Aug 1985. 14p. Contract W-7405-ENG-48. DE86013683 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013683.

A low voltage plasma arc is first established across the rails behind the projectile by switching a low voltage high current source across the rails to establish a plasma arc by vaporizing a fuse mounted on the back of the projectile, maintaining the voltage across the rails below the railgun breakdown voltage to prevent arc formation ahead of the projectile. After the plasma arc has been formed behind the projectile a discriminator switches the full energy bank across the rails to accelerate the projectile. A gas gun injector may be utilized to inject a projectile into the breech of a railgun. The invention permits the use of a gas gun or gun powder injector and an evacuated barrel without the risk of spurious arc formation in front of the projectile.

46356 **Transformer current sensor for superconducting magnetic coils.** Shen, S.S.; Wilson, C.T. (to Dept. of Energy). US Patent Application 6-723,674. 16 Apr 1985. 16p. Contract AC05-84OR21400. DE86013804 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013804.

The present invention is a current transformer for operating currents larger than 2kA (two kiloamps) that is capable of detecting a millivolt level resistive voltage in the presence of a large inductive voltage. Specifically, the present invention includes substantially cylindrical primary turns arranged to carry a primary current and substantially cylindrical secondary turns arranged coaxially with and only partially within the primary turns, the secondary turns including an active winding and a dummy winding, the active and dummy windings being coaxial, longitudinally separated and arranged to mutually cancel voltages excited by commonly experienced magnetic fields, the active winding but not the dummy winding being arranged within the primary turns.

4203 Lasers

REFER ALSO TO CITATION(S) 47025, 47120

46357 **(AD-A—167613/9/XAB) Investigation of single-crystal silicates for blue tunable lasers. Quarterly progress report No. 1, 1 September-30 November 1985.** Belt, R.F.; Catalano, J.A. (Litton Systems, Inc., Morris Plains, NJ (USA). Airtron Div.). Jan 1986. 37p. NTIS, PC A03/MF A01.

The single-crystal growth of rare earth silicates was investigated for the purpose of tunable-laser hosts. Silicates of the type R_2SiO_5, where R = La, Gd, Y, Lu, were prepared from stoichiometric melts and doped with Ce(3+) activators. Seed crystals were obtained from crystallized melt sections or by growth on an iridium wire. These seeds were utilized in standard Czochralski type growth to obtain larger single crystals. Cathodoluminescence experiments on both powders and single crystals showed wavelength shifts with different rare earth ions. The Gd, Y, and mixed crystals of Gd-Y silicates gave good bright emission with Ce(3+). The emission is broad band and covers the wavelength range of 370-525nm. The peak emission can be centered near 450-460nm by other compositions. Larger single crystals for laser hosts are under development.

46358 **(AD-A—167937/2/XAB) Statistical model for laser safety analysis.** Hermann, J.A. (Materials Research Labs., Ascot Vale (Australia)). Jan 1986. 25p. (MRL-R—983). NTIS, PC A02/MF A01.

A statistically-based model describing the effects of scintillations upon laser-beam propagation within the atmosphere has been investigated and has been applied to an analysis of laser safety.

46359 **(AD-A—167983/6/XAB) Optoelectronic devices and related physical phenomena in thin-film semiconductor configurations. Final report.** Lindsey, C.; Salzman, J.; Vahala, K.; Yariv. (California Inst. of Tech., Pasadena (USA). Dept. of Applied Physics). 1 May 1986. 28p. NTIS, PC A03/MF A01.

A research program in semiconductor lasers and related phenomena resulted in new understanding relating to coherent single lobe laser arrays and to structures displaying near-diffraction-limited output. Using their molecular beam epitaxial reactor, the authors demonstrated new unstable resonator geometry of semiconductor laser which potentially are capable of producing large-aperature high power without the need for arrays. Typical powers of approx. 0.4 Watt were demonstrated in a single mode. Basic theoretical analysis and experiments on noise in semiconductor lasers has resulted in a new quantum formulation that takes into account the amplitude to phase coupling. This coupling is characterized by a new dispersive parameter alpha. Direct measurement of alpha were performed.

46360 **(DRET—83-1328-DS-SR) Elementary processes and modelling in metallic vapor lasers.** Dubreuil, B. (Centre de Documentation de l'Armement (CEDOCAR), 75 - Paris (France). Direction des Recherches, Etudes et Techniques). Apr 1984. 143p. (In French). (PB—84-231539). NTIS (US Sales Only), PC E07/MF A01. File Number TI86752841.

After some recalls on principal mechanisms of collisional pumping existing in lasers excited by electric discharges, the different types of metal vapor lasers are described, are equally concerned in this description elementary mechanism physics and discharge cell technology. Then, in the particular case of the $He-Cd^+$ laser in positive column, the discharge has been modelized, in the typical conditions of the laser emission. An helium discharge model has been used which had been developed by the GREMI.

46361 **(FRNC-TH—2224) Contribution to study of laser emission in semiconductors II-VI with wide forbidden band: ZnTe and MgZnTe.** Roussel, C. (Institut National Polytechnique, 38 - Grenoble (France); Grenoble-1 Univ., 38 (France)). Oct 1984. 273p. (In French). NTIS (US Sales Only), PC A12/MF A01. File Number DE86752843.

By optical pumping and, overall, by pulsed electron bombardment, from a very specific facility, we show, analyze and characterize the laser emission of ZnTe and MgZnTe from 4°K to 300°K on Fabry-Perot cavities. We measure the optical gain and get very low laser threshold on good crystal quality cavities. We show that the laser emission kinetics depends on the excess rate in relation to the threshold on a classical model, a thermokinetic analysis accounts well for the different complex forms of spectra. On high purity crystals, the excitonic nature of different emission processes are precised at low excitation level (by photoluminescence), up to the ambient temperature; and, following the quantum models the emission under strong electron injection is attributed to inelastic collisions: exciton-exciton (for T<60°K) and exciton-free carriers (for T>60°K).

46362 **(LA-UR—86-2542) Fundamental mechanisms of optical damage in short-wavelength high-power lasers.** Haglund, R.F. Jr.; Tolk, N.H.; York, G.W. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy; Los Alamos National Lab., NM (USA)). Oct 1985. Contract W-7405-ENG-36. 13p. (CONF-8510101—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013830.

From Boulder damage symposium; Boulder, CO, USA (15 Oct 1985).

Evidence has been accumulating for many years that the physical mechanisms responsible for damage to optical materials in and from high-power, short-wave-length lasers (SWLs) differ in fundamental ways from the thermal processes identified in infrared and visible-wavelength laser damage problems. We propose that this difference stems primarily from the electronic nature of the absorption and excitation processes which occur when SWL photons strike an optical surface, and that electrons, ions and uv photons generated in the laser excitation cycle also contribute to optical damage. In this paper, we present recent experimental results which have pinpointed specific electronic excitation mechanisms which can operate in the high-power laser environment. In many optical materials of interest for SWLs, the deposition of electronic energy creates self-trapped excitons which decay through the energetic expulsion of atoms and molecules from the surface of the material. This erosion process is accompanied by the creation of permanent electronic defects which become nucleation sites for further damage. The relationship between these microscopic mechanisms and observed macroscopic damage phenomenology is discussed, along with evidence for the existence of a surface overlayer which may point the way to radically new techniques for protecting SWL optical elements from laser damage.

46363 **Subpicosecond KrF excimer-laser source.** Schwarzenbach, A.P.; Luk, T.S.; McIntyre, I.A.; Johann, U.; McPherson, A.; Boyer, K.; Rhodes, C.K. (Department of Physics, University of Illinois at Chicago, P.O. Box 4348, Chicago, Illinois 60680). *Optics Letters;* 11: No. 8, 499-501(Aug 1986).

A subpicosecond KrF* laser system capable of producing 20 +- 2-mJ pulses has been developed. The means of producing ultrashort seed pulses for the KrF/sup */ amplifier system and characteristics of the full system are described. It is shown that efficient subpicosecond energy extraction is possible.

46364 (AD-A—167846/5/XAB) Chinese Journal of Lasers (selected articles). Gan; Zhang. Translated from *Zhongguo Jiguang ;* **11**: No. 8, 449-463(22 Apr 1986). 54p. (FTD-ID(RS)T—0004-86). NTIS, PC A04/MF A01.

Past and future research progress on laser crystals in China is reviewed. Some proposals are offered in order to open up a new prospect for the development of laser crystals. Various methods for measuring different kinds of physical properties of laser glasses were also investigated, and the corresponding apparatus was installed. Emphasis is placed on the inspection of optical quality of large-size glass products, and a laser holographic interferometer for optical-homogeneity measurement was developed. This paper also reports some fundamental research results on laser glasses. By using laser glass spectroscopy, the special properties and structural state of rare earth ions in inorganic glasses were investigated. The study of spectral and luminescent properties of Nd doped glasses was emphasized. Further detailed studies of the influence of the glass bases on spectral properties of Nd ions and the energy-transfer process of Nd ions in glasses were made.

46365 Two-dimensional phase-locked semiconductor-laser array. Chow, W.W. (to Dept. of the Air Force, Washington, DC). US Patent Application 6-840,620. 17 Mar 1986. 14p. NTIS, PC A02/MF A01.

A phase-locked two-dimensional semiconductor laser array is disclosed that emits a unified wavefront using columns of individual lasers, each laser having a slant mirror between it and the other lasers in its column. The individual lasers are all evanescently coupled to the neighboring lasers. The slant mirrors reflect the light from the lasers next to it upwards out of the face of the array. The phase locking is accomplishd by the evanescent wave coupling.

46366 X-ray laser experiments research at the Nova Laser Facility. Matthews, D.L. (Univ. of California, Lawrence Livermore National Lab., CA). pp vp of Proceedings of the international congress on applications of lasers and electro-optics. Toledo, OH; Laser Institute of America (1985). (CONF-8511103—).

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

The author reviews the lasing phenomena and its applications at soft x-ray wavelengths. Included is a description of soft x-ray laser demonstration experiments at 20.6, 20.9 and 15.5 nm for optical laser pumped collisional excitation laser schemes, physics understanding of the phenomena, the new 10TW 2-beam facility at the Nova laser and near-term experiment's program. Ultimately, the authors are hoping to achieve efficient lasing at 3 to 5 nm at MW output power levels, with low-divergence highly-coherent beam properties. Near term their research will be performed at 20 to 15 nm wavelengths and will focus on achieving saturated output from the ASE amplifier and characterizing the beams divergence and mode structure.

46367 Real-time, low-cost laser diagnostic system. Ramos, T.J.; Lingenfelter, A.C. (Lawrence Livermore National Lab., Livermore, CA). pp vp of Proceedings of the international congress on applications of lasers and electro-optics. Toledo, OH; Laser Institute of America (1985). (CONF-8511103—).

From ICALEO international congress on the applications of lasers and electro-optics; San Francisco, CA, USA (11 Nov 1985).

The ability to make precision parts in laser metalworking operations demands a high degree of control over laser characteristics. Also, assurance of repeatable results from weld to weld requires diagnostic instrumentation and real-time availability to the laser operator of beam energy information. For optimal use of laser equipment, a diagnostic system should allow verification of such characteristics as beam mode and stability and permit their on-line adjustment, as needed. Ability to document and retrieve information on these characteristics as part of the fabrication qualification record, or for future reference, is another desired feature. The diagnostic system developed for laser metalworking requirements at LLNL has four major subsystems: (1) a standard model of a commercially available personal computer, (2) a frame grabber, (3) a TV camera, and (4) system control software. The computer requires sufficient capacity to process approximately 262K bytes of information per frame. Therefore, they use a 10 megabyte hard-disc drive plus a single floppy disc drive.

46368 Recent progress in high repetition rate high power, line-narrowed alexandrite laser. Sam, R.C.; Rapoport, R.; Matthews, S. (Military Laser Products, Allied Technologies Co., 31717 La Tienda Dr., Westlake Village, CA). pp 28-37 of Tunable solid state lasers. Hammerling, P.; Budgor, A.B.; Pinto, A. New York, NY; Springer-Verlag New York, Inc. (1985). (CONF-8406188—).

From Conference on tunable solid state lasers; La Jolla, CA, USA (13 Jun 1984).

This paper describes the specifications, conceptual design and development of a high repetition rate, high average power, line-narrowed, tunable alexandrite laser system. A brief description of the development of support hardware, experimental data obtained, difficulties encountered, and design modifications to resolve these problems is given. Also included is an update on current system performance.

46369 Alexandrite laser systems: Scaling to kilowatt powers. Johnannsen, D.C. pp 38-41 of Tunable solid state lasers. Hammerling, P.; Budgor, A.B.; Pinto, A. New York, NY; Springer-Verlag New York, Inc. (1985). (CONF-8406188—).

From Conference on tunable solid state lasers; La Jolla, CA, USA (13 Jun 1984).

With alexandrite laser systems producing tens of watts now developed, it is interesting to consider how powerful a system could be developed through the scaling up of existing designs. The most logical starting point for such a scaling is the 150 W system, which Allied is developing under contract to the Department of Energy (DOE), which is currently the most powerful alexandrite system in preparation. In this paper the author discusses how an optimization of parameters for maximum power production coupled with larger alexandrite elements might allow scaling to kilowatt power.

46370 Trivalent cerium doped crystals as tunable laser systems: Two bad apples. Hamilton, D.S. (Dept. of Physics and Inst. of Materials Science, Univ. of Connecticut, Storrs, CT). pp 80-90 of Tunable solid state lasers. Hammerling, P.; Budgor, A.B.; Pinto, A. New York, NY; Springer-Verlag New York, Inc. (1985). (CONF-8406188—).

From Conference on tunable solid state lasers; La Jolla, CA, USA (13 Jun 1984).

The 5d-4f transitions of trivalent doped crystals have broad emission bands with large oscillator strengths and near unity quantum efficiency. These characteristics make cerium systems strong candidates for tunable solid state lasers. However, two such cerium crystals will probably never lase. The first is Ce^{3+}:YAG where a strong excited state absorption quenches the lasing transition. Recent measurements have indicated that the excited state absorption terminates in the YAG conduction band with a peak cross-section of 1.0×10^{-17} cm^2 at 700 nm. Some of the general features of impurity ion to band spectra are discussed. The second system is Ce^{3+}:CaF_2 where a UV pump-induced photochromic center is produced following excitation of the cerium ions. The initial measurements of cerium-related transient absorptions in Ce^{3+}:YLF are also presented.

46371 Theoretical methods for the study of transition metals in crystals. Winter, N.W. ; Pitzer, R.M. (Lawrence Livermore National Lab., Livermore, CA). pp 164-171 of Tunable solid state lasers. Hammerling, P.; Budgor, A.B.; Pinto, A. New York, NY; Springer-Verlag New York, Inc. (1985). (CONF-8406188—). Contract W-7405-ENG-48.

From Conference on tunable solid state lasers; La Jolla, CA, USA (13 Jun 1984).

The characterization of the electronic structure of impurities in solids impacts a large class of phenomena and devices. It is particularly important for the systematic development of new solid state laser media. The large number of ion-host combinations that must be studied in order to optimize the linear and non-linear optical properties and the thermal and mechanical properties of the laser preclude a case-by-case experimental investigation. This sug-

gests that an aggressive theoretical effort to determine the optical properties of these materials will be useful in the search for new tunable solid state lasers.

46372 New harmonic materials: index engineering. Eimerl, D. (Lawrence Livermore National Lab., CA). *Proceedings of the International Conference on Lasers;* 555-556(Nov 1984). Contract W-7405-ENG-48.

The goal of advanced nonlinear materials research is to develop the capability of matching material parameters to a particular desired application. Index engineering is a method of adjusting the refractive indices of a material to obtain non-critical phase-matching over a range of wavelengths. The index is adjusted either by doping the crystal or by making solid solutions of structurally similar crystals. Thus, the lattice constants and the UV absorption edge are affected, changing both the birefringence and the wavelength dispersion. By an adroit choice of materials, some decoupling between the changes in the birefringence and the dispersion can be arranged. This paper describes its application to the KDP series of homologs.

46373 Thin-thick quadrature frequency conversion. Eimerl, D. (Lawrence Livermore National Lab., CA). *Proceedings of the International Conference on Lasers;* 557-559(Nov 1984). Contract W-7405-ENG-48.

The quadrature conversion scheme is a method of generating the second harmonic. The scheme, which uses two crystals in series, has several advantages over single-crystal or other two crystal schemes. The most important is that it is capable of high conversion efficiency over a large dynamic range of drive intensity and detuning angle.

46374 Electro-optical switches with plasma electrodes. Goldhar, J.; Henesian, M.A. (Lawrence Livermore National Lab., CA). *Optics Letters;* 9: No. 3, 73-75(Mar 1984). Contract W-7405-ENG-48.

A transparent electrode concept using low-pressure ionized gas in the glow discharge regime is proposed for large-aperture electro-optic switch applications. A longitudinal Pockels cell and an electro-optically tuned second-harmonic-generation cell using KDP have successfully demonstrated the concept. 4 references, 4 figures.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 45679, 45900, 45902, 45922, 45924, 45925, 45948, 46241, 47027

46375 (AD-A—167874/7/XAB) Analysis of the performance of a vertically oriented, gas-loaded, variable-conductance heat pipe. Master's thesis. Glover, G.A. (Naval Postgraduate School, Monterey, CA (USA)). Mar 1986. 54p. NTIS, PC A04/MF A01.

An analysis of steady-state operation of a vertically oriented, variable-conductance heat pipe is presented. The effects of binary mass diffusion, axial pipe wall conduction, and gravitational effects, caused by the difference in molecular weight of the non-condensible gas and the working fluid are incorporated. Analytical expressions for the conservation of mass, momentum, and energy are combined along with equations of state to describe steady-state operation of the heat pipe. These expressions are combined to form a system of three differential equations with three unknowns; working-fluid vapor velocity, mass fraction, and temperature. These equations are nondimensionalized, and an iteration scheme for numerical solution of the equations is presented.

46376 (AEEW-R—1928) Experimental investigation of untriggered film boiling collapse. Naylor, P. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1985. 43p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703163.

Film boiling has been investigated in a stagnant pool, using polished brass or anodised aluminium alloy rods in water. Experimental boiling curves were obtained, and pronounced ripples on the vapour/liquid interface were photographed. A criterion for untriggered film boiling collapse is proposed, consistent with experimental results. Application of the results to molten fuel coolant interaction studies is discussed.

46377 (AEEW-R—1929) Experimental investigation of triggered film boiling destabilisation. Naylor, P. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1985. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703164.

Film boiling was established on a polished brass rod in water, collapse being initiated by either a pressure pulse or a transient bulk water flow. This work is relevant to the triggering stage of a molten fuel-coolant interaction, and a criterion is proposed for triggered film boiling collapse with pressure pulse.

46378 (AEEW-R—1930) Theoretical model of steady state film boiling and its comparison with experimental results. Naylor, P. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1985. 52p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86703165.

The model described here is for a vertical cylindrical heater with a hemispherical lower end. It was developed as part of an experimental investigation of untriggered and triggered film boiling collapse and the validity of the assumptions is assessed for the range of experimental conditions. Comparison is made with theoretical results.

46379 (AERE-R—11930) Data acquisition software system for velocity and turbulence measurements on the two dimensional channel flow rig. Gillespie, R.; Martin, S.R. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Sep 1985. 35p. H.M. Stationery Office, London, price Pound 5.00.

A software system is described for two component velocity measurements on a turbulent water flow. The software runs on a PDP11/73 with RT11 version 5 and TSX. Signals from a two component laser doppler system in a ribbed flow channel were collected by photomultipliers and fed to two Dantec 55N21 frequency trackers via 55N12 frequency shift units. Digital data output from the trackers was sent to a PDP11/73 computer via a Dantec 57G20 buffer interface and a DEC DRV11 interface board. Software was written to collect data through this interface at rates up to 150k words per second. Data processing software was included to give two velocity components and their cross correlations. This allowed the calculation of the Reynolds stresses as well as the velocities for comparison with theoretical models. Other data processing routines allowed spectral analysis of the data. Means of dealing with signal dropouts are discussed. The use of the software is also described.

46380 (EGG-J—01586) Heat transfer in gas tungsten arc welding. Smartt, H.B.; Stewart, J.A.; Einerson, C.J. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1986. Contract AC07-76ID01570. 14p. (CONF-8510160—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013457.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Ontario, Canada (13 Oct 1985).

The heat transferred from an electrode negative, argon gas tungsten arc to an anode has been measured for a wide range of conditions suitable for mechanized welding applications. The results are given as (1) the arc efficiency; and (2) the anode heat and current input distribution functional shapes and radii for various anode materials and groove shapes over a wide range of current and voltage, using different electrode geometries, as well as both He and Ar-He shielding gases. The nominal arc is Gaussian with a diameter of about 4 mm and a heat transfer efficiency to the anode of about 75%. Variations from these values are discussed in terms of current knowledge of the electrical and thermal energy transport mechanisms. A new method of measuring the heat transferred from the arc to the anode, using a boiling liquid nitrogen calorimeter, has been developed which gives rapid, accurate values.

46381 (SAND—84-1563) Space Marching Inverse Conduction Code. Hills, R.G.; Hensel, E.C. (New Mexico State Univ., Las Cruces (USA). Dept. of Mechanical Engineering). Jul 1986. Contract AC04-76DP00789. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86014079.

This document describes the Space Marching Inverse Conduction Code. This code models the one dimensional inverse heat conduction problem using a space marching finite difference technique. In addition to providing surface condition estimates, the code also provides estimates for the resolving power and accuracy of the estimates. The program also has the ability to handle simple phase change problems. 35 refs., 35 figs.

46382 **(UCID—20680) PLUS family: a set of computer programs to evaluate analytical solutions of the diffusion equation.** Montan, D.N. (Lawrence Livermore National Lab., CA (USA)). Feb 1986. Contract W-7405-ENG-48. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE86014098.

This report is intended to describe, document and provide instructions for the use of a set of computer programs commonly referred to as the PLUS family. These programs were designed to numerically evaluate simple analytic solutions of the diffusion equation. The original member of the family, a program called PLUS, was written to provide calculational support for a study of the storage of nuclear waste in geological media. Originally, PLUS computed temperture changes at points in space and time due to a finite length line source. The need to handle arrays of sources led to modifications. To this end, PLUS was changed to subroutine status and new programs were written: CELERY, to control the I/O chores; STALKS, with storage space for an arbitrary array of sources; MIDNITE, to produce thermal contours in and/or about the array. The newest members of the family, TWIGS, and DAYLITE were created to do some of the things (uniform arrays of identical sources) that STALKS and MIDNITE could do but without the need for additional storage space. The original design of these programs was for thermal calculations, however, diffusion equation is used in the study of a number of other field, for example, fluid flow in porous media (hydrology, petroleum reservoirs), and the PLUS family may find other possible homes. 9 refs., 13 figs.

46383 **(UCID—20824) TOPAZ2D: a two-dimensional finite element code for heat transfer analysis, electrostatics, and magnetostatics problems.** Shapiro, A.B. (Lawrence Livermore National Lab., CA (USA). Mechanical Engineering Dept.). Jul 1986. Contract W-7405-ENG-48. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014749.

TOPAZ2D is a two-dimensional implicit finite element computer code for heat transfer analysis, electrostatics, and magnetostatics problems. This report provides a user's manual for TOPAZ2D and a description of the numerical algorithms used. Sample problems with analytical solutions are presented. TOPAZ2D has been implemented on the CRAY and VAX computers.

46384 **Nearly-implicit hydrodynamic numerical scheme for two-phase flows.** Trapp, J.A.; Riemke, R.A. (Department of Mechanical Engineering, University of Colorado, Denver, Colorado 80202). *Journal of Computational Physics;* **66**: No. 1, 62-82(Sep 1986).

This article presents an extension of the semi-implicit numerical scheme for two-phase flow simulation. The extension uses an implicit evaluation of the convective fluxes and thus eliminates the material Courant stability restriction. The new algorithm involves a two-step approach for the mass and energy equations and a single fully-implicit step for the momentum evaluations. Some analysis and accuracy considerations for the scheme are also presented.

46385 **Time-of-flight characterization of pulsed supersonic helium free-jet expansions.** Kay, B.D.; Raymond, T.D.; Rice, J.K. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **57**: No. 9, 2266-2273(Sep 1986). Contract AC04-76DP00789.

A synchronous time-of-flight (TOF) technique is employed to make velocity distribution measurements in pulsed supersonic free-jet expansions. For helium expansions, the flow attains a steady—state condition with a terminal Mach number of 80, on a 50-μs time scale. The transient behavior is primarily due to the mechanical action of the valve. For a 650-μs-wide pulse, greater than 95% of the atoms issuing from the pulsed nozzle can be described by the steady-state parameters. However, the velocity dispersion increases at both the leading and trailing edges of the pulse. This dispersion can be quantitatively described by incorporating a time-dependent Mach number into the standard steady-state flux velocity distribution function.

46386 **Viscous resuspension.** Leighton, D.; Acrivos, A. (Stanford Univ., CA). *Chemical Engineering Science;* **41**: No. 6, 1377-1384(1986).

The resuspension of a settled layer of particles in a shear flow, typically associated with turbulence, has also been found to occur under viscous conditions (Gadala-Maria, F.A., 1979, Ph.D. Thesis, Stanford University). In this work the authors demonstrate that viscous resuspension, characterized by the equilibrium height achieved by an initially settled bed of particles expanding in the presence of an applied shear stress, results from a balance between the downward flux of particles due to gravity and an upward flux arising from shear-induced particle diffusion. Predictions of this equilibrium height using independent measurements of the shear-induced diffusion coefficient are shown to be in approximate agreement with experimental observations.

4205 Materials Testing

REFER ALSO TO CITATION(S) 46132

46387 **(CONF-860856—1) Multiparameter methods with pulsed eddy currents.** Dodd, C.V.; Deeds, W.E. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014224.

From Conference on review of progress in quantitative NDE; San Diego, CA, USA (3 Aug 1986).

Multiparameter methods have been used for a number of years to distinguish certain material properties from others that may be varying in the same eddy current inspection. Usually the measured data are the magnitudes and phases of the eddy currents at several fixed frequencies. Alternatively, the necessary data can be obtained from pulsed eddy currents by measuring the pulse heights at various times or the times to reach various pulse heights. Such data can be used to analyze the pulse into various Fourier components, but that is time consuming and unnecessary. The raw data (for example, the pulse heights at various times) can be used as variables in polynomial approximations to the various properties in exactly the same way has been used with the multifrequency, multiparameter method. This approach has several advantages, including simpler equipment, ability to use higher frequencies, and less modification required for different inspection problems.

46388 **(EGG-M—06485) Comparison of experimental results for surface-flawed specimens versus predictions based on COD design curve.** Reuter, W.G.; Epstein, J.S. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 12p. (CONF-8505295—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013464.

From Fitness for purpose in welded construction meeting; Philadelphia, PA, USA (13 May 1985).

The purpose of this paper is to compare experimental results, obtained from surface flawed specimens, with predictions based on the COD design curve. The comparison is based on conditions for initiation of crack growth.

46389 **(UCRL—15715) Design of an acousto-optic goniometric specimens mount. Report No. 2 on modeling of acoustic microscopes.** Evans, G.E.; Rice, D.L.; Schwartz, M. (Houston Univ., TX (USA). Dept. of Mechanical Engineering). 1 May 1985. Contract W-7405-ENG-48. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86013902.

The proposed project is to design, build, and test an acousto-optic goniometric specimen mount. It will be used in a related experiment, evaluating reflection of sound from the surfaces of various specimens. The desired specimen mount is one which will utilize as much of the existing testing apparatus as possible. The mount must provide a means of scanning the sound beam with a laser.

46390 (UCRL—93185) Nanosecond two-dimensional imaging using tomographic techniques. Koehler, H.A.; Jacoby, B.A. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 20p. (CONF-860950—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86008164.

From 17. international congress on high speed photography and photonics; Pretoria, South Africa (1 Sep 1986).

Several fast, single transient data imaging systems have been developed for time-resolved imaging of pulsed radiation sources. Both MCP intensified solid-state, two-dimensional framing cameras and streak cameras/solid-state camera systems are used. The streak camera system yields small, two-dimensional images with limited spatial resolution (≦150 spatial points) and ≦0.5 nsec exposure. It is those streak camera systems developed at Lawrence Livermore National Laboratory that are used for obtaining time-resolved, tomographically reconstructed, two-dimensional images of electron and x-ray beams.

46391 (UCRL—94282) Sensitivity of uniaxial failure on spatial variations of initial geometry, initial microcrack density, and time dependent material properties. Stout, R.B. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 12p. (CONF-860894—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014437.

From 4. international RILEM symposium on creep and shrinkage of concrete: mathematical modeling; Evanston, IL, USA (26 Aug 1986).

A model for the non-uniform creation of microcracks during uniaxial tensile testing has been discussed. The model describes failure due to microcrack creation kinetics. Future extensions of the model to represent microcrack growth and coalescence are necessary in order to compare with experimental data that indicates a decrease of microcrack number density during failure. Also, a more complete mathematical treatment for multi-species of microcracks and their interactions is required.

46392 (Y/DW—642) Analytic signal converter for nondestructive testing. Duncan, M.G. (Oak Ridge Y-12 Plant, TN (USA)). 1986. Contract AC05-84OS21400. 9p. (CONF-8603139—1). NTIS, PC A02/MF A01. File Number DE86012720.

From Southeastcon '86: IEEE region 3 conference and exhibit; Richmond, VA, USA (23 Mar 1986).

An analytic signal converter was developed to improve flaw detection in parts. The converter can resolve echoes 700 ns apart. The converter oprerates in real-time by using a single-sideband conversion technique, Weaver's Method. The transducer range is 1 to 40 MHz.

4206 Safety Engineering

46393 (LA-UR—86-2396) Methods for air cleaning system design and accident analysis. Gregory, W.S.; Nichols, B.D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 7p. (CONF-860820—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013841.

From 19. DOE/NRC nuclear air cleaning conference; Seattle, WA, USA (17 Aug 1986).

This paper describes methods, in the form of a handbook and five computer codes, that can be used for air cleaning system design and accident analysis. Four of the codes were developed primarily at the Los Alamos National Laboratory, and one was developed in France. Tools such as these are used to design ventilation systems in the mining industry but do not seem to be commonly used in the nuclear industry. For example, the Nuclear Air Cleaning Handbook is an excellent design reference, but it fails to include information on computer codes that can be used to aid in the design process. These computer codes allow the analyst to use the handbook information to form all the elements of a complete system design. Because these analysis methods are in the form of computer codes, they allow the analyst to investigate many alternative designs. In addition, the effects of many accident scenarios on the operation of the air cleaning system can be evaluated. These tools originally were intended for accident analysis, but they have been used mostly as design tools by several architect-engineering firms. The Cray, VAX, and personal computer versions of the codes, an accident analysis handbook, and the codes' availability will be discussed. The application of these codes to several design operations of nuclear facilities will be illustrated, and their use to analyze the effect of several accident scenarios also will be described.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 45794, 45964, 46222, 46355, 46612, 47065

46394 (BDX—613-3510) Automation of printed wiring assembly manufacturing. Final report. Douglass, R.C. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). Jul 1986. Contract AC04-76DP00613. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014654.

A Robotic Component Preparation (RCP) workcell was designed, developed, and implemented into the production system. The RCP system was initially released for tinning and binning all axial leaded components but is capable with further development for use on radial leaded parts as well. A technique was developed to produce printed wiring assemblies while still in the multi-image printed wiring board panel that complements the component insertion and machine soldering processes with a measurable gain in productivity. Feasibility studies were conducted into the use of automated systems for solder joint and component insertion verification. A plan for incorporating a Factory Management System that offers material and information control was developed. The Factory Management System utilizes bar codes and carousel storage systems for material control and a Shop Floor Information System (SFIS) for information management.

46395 (CONF-860755—1) Implementation of FORPS on a NOVIX Beta Board. Matheus, C.J. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013403.

From 4. Rochester conference; Rochester, NY, USA (11 Jul 1986).

FORPS is a Forth-based Production System developed for fast, real time control problems. It employs a very small and efficient inference engine to cycle through sets of IF-THEN production rules. The original version of FORPS was written in polyFORTH for a 68000 microcomputer. Recently, FORPS has been ported to the NOVIX Beta Board running NOVIX FORTH. Topics discussed are the FORPS production system, including rule definitions, dictionary entry, the rule table, the inference engine, and the translation to the NOVIX board. The translation from polyFORTH to novix FORTH resulted in a relative speedup of greater than 28:1 for the Towers of Hanoi artificial intelligence problem. (DWL) 4 refs., 4 figs., 1 tab.

46396 (IAEA-TECDOC—363) Selected topics in nuclear electronics. (International Atomic Energy Agency, Vienna (Austria)). Jan 1986. 203p. NTIS (US Sales Only), PC A10/MF A01. File Number DE86703195.

The IAEA training courses in the field of nuclear electronics heavily rely upon practical work in the laboratory. Accordingly, the IAEA has produced and published the Nuclear Electronics Laboratory Manual (TECDOC 309) where the experience on organizing the efficient practical training in nuclear electronics was compiled. The present publication is focused on the theoretical understanding of basic electronic circuits and is of particular importance to the attendees of the IAEA training course. The present publication does not copy any available book on nuclear electronics and instrumentation. On purpose, it does not describe the elementary electronics circuits as applied in nuclear instruments; they can be found in books. It starts the nuclear electronics study on the instruments level, continues to describe the technology and circuitries on the board level, and only in some exceptional cases investigates the circuits on the components level. It is believed that such an approach better reflects the advanced status of nuclear electronics and the philosophy of the modern design of nuclear instruments. For illustration, and wherever it appeared useful, some commercial instruments are described and analyzed. figs and tabs.

46397 (INIS-mf—10173, pp 62) **UA2 100 Mhz Flash-ADC electronics.** Iacopini, E. Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46398 **(LA-UR—86-2372) Energy storage transformer power conditioning systems for Megajoule class flux compression generators.** Reinovsky, R.E.; Colclaser, R.G.; Welby, J.M.; Lopez, E.A. (Los Alamos National Lab., NM (USA); Air Force Weapons Lab., Kirtland AFB, NM (USA); Maxwell Labs., Inc., Albuquerque, NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-860703—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013850.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

Circuit and energy storage transformer configurations are developed to match high impedance loads to low impedance sources. With the secondary open, a large di/dt is produced in the primary circuit by inserting a resistance, characteristic of an opening switch, and the load circuit is connected using a preset spark gap. Transformer design concepts using a foil-MYLAR "sandwich" for the secondary winding are described, permitting close primary-secondary coupling. Transformer experiments driven by a 0.25 MJ capacitor bank support the overall system concepts. A compact flux compression generator-transformer system is described.

46399 **(LA-UR—86-2379) Results from plasma compression opening switch experiments.** Goforth, J.H.; Greene, A.E. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 8p. (CONF-860703—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013847.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

During the past three decades, a wide variety of explosive-driven magnetic-flux compression generators (explosive generators) has been developed. As the explosive-pulsed power field has expanded, more refined techniques for coupling explosive generator outputs to specialized loads have been sought. In many instances, the most efficient way to deliver current rapidly to a load from an explosive generator powered circuit is to make use of inductive storage techniques. Such techniques, however, require opening switches with appropriate characteristics for both the specific generator and the load to be coupled. For use with explosive plate generators, an adaptation of the plasma compression switches described by Pavlovskii et al has been developed and tested both with static and dynamic loads. The new plasma compression switch geometry is well suited for coupling explosive plate generators to low inductance loads requiring pulse risetimes of $\leqq 1$ μs and currents up to 4 to 5 MA. We discuss here the design, operating characterisitics and limits of this planar plasma compression switch. For use with coaxial explosive generators (or for load pulses much in excess of 5 MA) the cylindrical geometry described originally by Pavlovskii seems preferable. Based on our own limited experience with cylindrical geometry and currently available data, we project a maximum practical size and operating limits for such switches. 14 refs.

46400 **(LA-UR—86-2387) Design of a fast-plate generator driving plasma flow switch.** Caird, R.S.; Goforth, J.H.; Turchi, P.J. (Los Alamos National Lab., NM (USA); R and D Associates, Alexandria, VA (USA)). 1986. Contract W-7405-ENG-36. 22p. (CONF-860703—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013843.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

Over the last fifteen years, there has been continuing interest in the use of magnetic flux compression generators to drive plasma implosion loads. Studies of fast plate-type generators coupled to cylindrical foil-plasma discharges in z-pinch geometry indicated that operation in the few microsecond time regime (generator time $\approx$ implosion time) might be successful. Later experiments and two-dimensional MHD calculations demonstrated that penetration of the effects of cold, nonmoving boundaries into the plasma implosion, combined with Rayleigh-Taylor instability, prevents practical attainment of microsecond implosions of cylindrical plasmas (a few cm or less in axial extent). Use of longer plasmas and/or shorter implosion times, however, implies higher effective driving voltages and shorter current risetimes at the load. Since explosively-driven plate generators may already represent the limit of generator performance in terms of speed, it is therefore necessary to include an intermediate stage of power conditioning between microsecond generators and submicrosecond implosion loads. The present paper discusses coupling the plasma flow switch to a fast plate generator in order to accumulate magnetic energy in vacuum on a few microsecond timescale and then release this energy rapidly to a submicrosecond implosion load.

46401 **(LA-UR—86-2412) Magnetic flux compression generator powered electron beam experiments.** Freeman, B.L.; Erickson, D.J.; Fowler, C.M.; Hoeberling, R.F.; King, J.C.; Kruse, P.J.; Peratt, A.L.; Rickel, D.G.; Thode, L.E.; Toevs, J.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 10p. (CONF-860703—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013839.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

We have combined several technologies in a rather conservative fashion to perform feasibility experiments to power a vacuum, electron beam diode with an explosive power supply. The magnetic flux compression generator used in these experiments was the 13.2-cm-wide by 52.8-cm-long plate generator. The output of this device was switched into an air-core, foil-wound, step-up transformer with a turn ratio of 30:1. The transformer and diode were connected through a 9-m-long piece of Sieverts high-voltage cable. The diode structure consisted of a high-voltage terminal on a stacked-ring grading structure with a 5-cm-diameter stalk to support a 12.7-cm-diameter field emission cathode. The cathode-anode gap was 2.5 cm, and the anode was 6.35-micron--thick aluminized mylar. Currents of $\geqq 14$ kA and voltages of $\geqq 540$ kV were achieved with a pulse length of $\geqq 100$ ns. Theoretical predictions agree with experimental performance until the diode shorted. However, this event limited the ultimate performance of the experiments. We consider diode shorting to be a major problem to be dealt with in future experiments involving >1 μs power pulses. This approach to powering electron beams should prove useful for experiments requiring only a few events or for very high-energy diode design and scaling tests. 11 figs.

46402 **(SAND—85-8025) Automated data acquisition system for multiple thermal cycling tests.** Condreva, K.J. (Sandia National Labs., Livermore, CA (USA). Electronic Subsystems Div.). Jul 1986. Contract AC04-76DR00789. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014745.

This report describes a 64-channel data acquisition system which was developed to simultaneously monitor up to 7 electronic component assemblies that are undergoing thermal cycling as part of their production acceptance testing. The 64 channels are scanned sequentially with a sampling time of 15 μsec/channel. This results in a 66.7-kHz scan rate, or a 1.04-kHz sample rate for each data channel. Since saving all of the data acquired in a test would require a prohibitive amount of memory, the data are compressed to a set of data values once every 15 minutes, plus anomalies. The system can store up to 2 megabytes of data in nonvolatile disc memory.

46403 **(SAND—86-0845C) Performance of polysilicon gate CMOS devices in space and SDI environments.** Schwank, J.R.; Sexton, F.W.; Winokur, P.S.; Fleetwood, D.M.; Dressendorfer, P.V. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1986. Contract AC04-76DP00789. 3p. (CONF-860966—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009025.

From Space electronics conference; Albuquerque, NM, USA (9 Sep 1986).

The purpose of this work is to investigate the radiation response of state-of-the-art hardened polysilicon gate CMOS devices in space and SDI environments. To simulate the different radiation evnironments both very high and very low dose rate sources will be used. The results will be examined from the basic mechanisms involved which will be correlated to device functionality. In addition, we also will examine the radiation responses of devices exposed to large, short duration pulses after having been previously irradiated at much lower dose rates.

46404 **(SAND—86-1600C) Consensus on powering and grounding sensitive electronic equipment.** Key, T.S.; Martzloff, F.D. (Sandia National Labs., Albuquerque, NM (USA); National Bureau of Standards, Washington, DC (USA)). 1986. Contract AC04-76DP00789. 20p. (CONF-860903—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013350.

From IEEE-Industry Applications Society annual meeting; Denver, CO, USA (28 Sep 1986).

As sensitive electronic processing systems proliferate in our facilities so do power-related problems. Efforts to alleviate these problems have ranged from installing expensive power conditioning equipment to applying special grounding techniques not found in conventional safe grounding practice. Understanding of what is actually going on has been lacking. We find elaborate power systems, modified from basic practice to the extent of being unsafe, that continue to be plagued with powering- and grounding-related problems. Out of this chaos we are persuaded to study and understand the complexities of the problem and to begin developing good practices. This is the objective of the IEEE Working Group on Powering and Grounding Sensitive Electronic Equipment, Standards Project P1100. We will introduce Project P1100, preview its scope and technical content and, most importantly, invite participation in this seriously needed consensus standard activity.

46405 **(UCID—20788) Microstrip antenna modeling and measurement at high frequencies.** Bevensee, R.M. (Lawrence Livermore National Lab., CA (USA)). 30 Apr 1986. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014404.

This report addresses the task C(i) of the Proposal for Microstrip Antenna Modeling and Measurement at High Frequencies by the writer, July 1985. The task is: Assess the advantages and disadvantages of the three computational approaches outlined in the Proposal, including any difficulties to be resolved and an estimate of the time required to implement each approach. The three approaches are (1) Finite Difference, (2) Sommerfeld-GTD-MOM, and (3) Surface Intergral Equations - MOM. These are discussed in turn.

46406 **(UCRL—94855) Comparison of numerical helical generator simulations with experimental results.** Abe, D.K.; Chase, J.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 8p. (CONF-860703—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014447.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

We have made comparisons between the experimental results on small helical flux compression generators, described elsewhere at this conference, and computer simulations. A 2D hydrodynamic computer simulation was used to generate the acceleration profile of the armature of the generators. The electrical behavior of the generators was predicted using the CIRC computer code. Various generator loss models were examined, including resistive and flux trapping models. A discussion of the comparisons will be given.

46407 **(UCRL—94856) CIRC: a specialized circuit analysis computer simulation program for a high explosive generator model.** Chase, J.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 9p. (CONF-860703—27). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014448.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

CIRC is a fast computer model for the simulation of the performance of a high explosive helical magnetic flux compression generator and a load. These separate models are joined by a lumped circuit solved by CIRC as a multinode network equation with time as the independent variable. In this paper the generator model, as it currently exists, will be detailed. It is the "generator equation" that is numerically integrated by CIRC. The units used in CIRC are time in microseconds, mass in grams, distance in centimeters, current in 10^7 amperes, voltage in 10^4 volts, inductance in nanohenries, resistance in milli-ohms and magnetic field strength in megagauss.

46408 **Equilibrium properties of thin-oxide metal-oxide-semiconductor diodes.** Butler, M.A.; Seager, C.H. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 60: No. 6, 2137-2141(15 Sep 1986). Contract AC04-76DP00789.

The zero-bias resistance and high frequency capacitance of Al- and Pd-gated thin-oxide metal-oxide-semiconductor diodes have been measured as a function of temperature. The temperature dependence of the semiconductor barrier height is found to be large, primarily due to inversion effects. The relatively low activation energies observed for the zero-bias resistance, as well as actual measurements of spatial variations in device current, strongly suggest the presence of large variations in the semiconductor band bending. These variations may be directly related to thickness nonuniformities which are known to occur in SiO_2 films processed at low temperatures.

46409 **Theory of response of radiation sensing field-effect transistors in zero-bias operation.** Hughes, R.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* 60: No. 3, 1216-1217(1 Aug 1986). Contract AC04-76DP00789.

Radiation sensing field-effect transistors operated at zero bias show a low-dose response that is roughly linear in the thickness of the gate oxide. The same devices show a thickness squared dependence if a bias is applied during the irradiation. This effect can be explained by examining the effect of diffusion and electron trapping on the buildup of net positive charge in the gate oxide.

46410 **Reusable fast opening switch.** VanDevender, J.P.; Emin, D. (to Dept. of Energy, Washington, DC). US Patent 4,598,338. 1 Jul 1986. Filed date 21 Dec 1983. vp.

A reusable fast opening switch is described for pulse power applications comprising: a pair of spaced, plate, conductors; a bulk magnetic semiconductor disposed between the conductors, the magnetic semiconductor being highly conductive below a critical temperature (T/sub C/) and rapidly transforming into an insulator above T/sub C/ by undergoing at least an order of magnitude change in resistivity for a temperature change 10°C: and shock absorber means for protecting the semiconductor from shock waves generated during a resistivity transition.

46411 **Means of manufacturing annular arrays.** Day, R.A. (to Dept. of Energy). US Patent Application 6-786,384. 10 Oct 1985. 15p. Contract AT03-78SF70030. DE86013657 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013657.

A method is described for manufacturing an annular acoustic transducer array from a plate of transducer material, which enables production of precision aligned arrays at low cost. The circular plate is sawed along at least two lines that are radial to the axis of the plate. At steps along each radial cut, the plate is rotated first in one direction and then in an opposite direction by a predetermined angle such as slightly less than 90°. The cuts result in the forming of several largely ring-shaped lands, each largely ring-shaped land being joined to the other rings of different radii by thin portions of the plate, and each ring being cut into segments. The bridges that join different rings hold the transducer together until it can be mounted on a lens.

46412 **Piezoelectric shear wave resonator and method of making same.** Wang, J.S.; Lakin, K.M.; Landin, A.R. (to Dept. of Energy). US Patent Application 6-736,164. 20 May 1985. 36p. Contract W-7405-ENG-82. DE86013722 NTIS, PC A03/MF A01; GPO Dep. File Number DE86013722.

An acoustic shear wave resonator comprising a piezoelectric film having its C-axis substantially inclined from the film normal such that the shear wave coupling coefficient significantly exceeds the longitudinal wave coupling coefficient, whereby the film is capable of shear wave resonance, and means for exciting said film to resonate. The film is prepared by deposition in a dc planar magnetron sputtering system to which a supplemental electric field is applied. The resonator structure may also include a semiconductor material having a positive temperature coefficient of resonance such that the resonator has a temperature coefficient of resonance approaching 0 ppM/°C.

4209 Waste Processing Plants And Equipment

46413 **(DOE/CE/40568—T1) Applied fields for energy conservation, water treatment, and industrial applications. Final report.** Reimers, R.S.; Bock, S.F.; White, L.E. (Tulane Univ., New Orleans, LA (USA). Dept. of Environmental Health Sciences). Jun 1986. Contract FG01-82CE40568. 387p. NTIS, PC A17/MF A01. File Number DE86014306.

A detailed evaluation was performed on the use of applied fields (nonionizing radiations, ultrasound, magnetic fields, etc.) for industrial waste treatment, wastewater treatment, and disinfection. Other industrial uses of applied fields and biological considerations were also studied. The evaluation was conducted in the following phases: literature review and personal contacts, papers from field and laboratory professionals, and a workshop with contributed papers. (DLC)

4210 Combustion Systems

REFER ALSO TO CITATION(S) 46042, 46098, 46099, 46100, 46101, 46105, 46108, 46328

46414 **(UCRL—93040) Chemical kinetic analysis of pulse combustors.** Westbrook, C.K.; Keller, J.O. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Apr 1986. Contract W-7405-ENG-48. 21p. (CONF-860904—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009895.

From International gas research conference; Toronto, Canada (8 Sep 1986).

A detailed numerical model is used to study the role of chemical kinetics in the operation of pulse combustors. The contributions of kinetic factors are shown to influence the composition limits, although the existence of a rich limit in some pulse combustors under near-stoichiometric conditions is shown to be determined by mixing limitations. The effects of changes in fuel composition and dilution by inert additives including carbon monoxide and molecular nitrogen on the operation of the pulse combustor are interpreted through their influence on the kinetics of the reignition process. 12 refs., 3 figs.

4220 Underground Engineering

46415 **(SAND—86-1084C) Downhole radar system for fracture detection.** Chang, H.T. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 6p. (CONF-860926—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86009854.

From Geothermal Resources Council annual meeting; Palm Springs, CA, USA (29 Sep 1986).

A borehole radar prototype was designed based on theoretical considerations. Experiments were conducted at a granite quarry where an existing flame-cut slot was used to simulate a fracture. The radar returns from this simulated fracture were detectable in boreholes located at distances of up to 12 meters from the fracture. Engineering design for a downhole radar system is almost complete. This system, including the directional antennas, is fabricated into a tool to be used in a borehole.

4250 Power Cycles

46416 **(ANL-CT—86-1) Reversing Flow Test Facility. Technical report, March 1986.** Roach, P.D. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 76p. NTIS, PC A05/MF A01; GPO Dep. File Number DE86014615.

The Reversing Flow Test Facility (RFTF) is intended for the study of fluid flow and heat transfer under the reversing-flow conditions that occur in Stirling engines. the facility consists of four major parts: (1) Mechanical Drive - two cylinders with cam-driven pistons which generate the reversing gas flow, (2) Test Section - a U-shaped section containing instrumented test pieces, (3) Instruments -l high-speed transducers for measuring gas pressure and temperature, piston positions, and other system parameters, and (4) Data Acquisition System - a computer-based system able to acquire, store, display and analyze the data from the instruments. The RFTF can operate at pressures up to 8.0 MPa, hot-side temperatures to 800°C, and flow-reversal frequencies to 50 Hz. Operation to data has used helium as the working gas at pressures of 3.0 and 6.0 MPa, at ambient temperature, and at frequencies from 1 to 50 Hz. The results show that both frictional and inertial parts of the pressure drop are significant in the heater, coolers and connecting tubes; the inertial part is negligible in the regenerators. In all cases, the frictional part of the pressure drop is nearly in phase with the mass flow. 18 refs., 22 figs., 13 tabs.

46417 **(DOE/NASA—1005-9) Overview of the 1986 free-piston Stirling SP-100 activities at the NASA Lewis Research Center.** Slaby, J.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1986. Contract AI05-82OR21005. 19p. (NASA-TM—87305; CONF-860810—20). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010333.

From Intersociety energy conversion engineering conference; San Diego, CA, USA (25 Aug 1986).

An overview of the National Aeronautics and Space Administration (NASA) Lewis Research Center SP-100 free-piston Stirling engine activities is presented. These activities include a free-piston Stirling space-power technology feasibility demonstration project as part of the SP-100 program being conducted in support of the Department of Defense (DOD), Department of Energy (DOE), and NASA. The space-power Stirling advanced technology effort, under SP-100, addresses the status of the 25 kWe Space Power Demonstrator Engine (SPDE) including test results. Future space-power projections are presented along with a description of a study that will investigate the feasibility of scaling a single-cylinder free-piston Stirling space-power module to the 150 kW power range. Design parameters and conceptual design features will be presented for a 25 kWe, single-cylinder free-piston Stirling space-power converter. A description of a hydrodynamic gas bearing concept will be presented whereby the displacer of a 1 kWe free-piston Stirling engine is modified to demonstrate the bearing concept. And finally the goals of a conceptual design for a 25 kWe Solar Advanced Stirling Conversion System capable of delivering electric power to an electric utility grid will be discussed. The solar work is under an interagency agreement between DOE/Sandia National Laboratory and NASA Lewis.

43 PARTICLE ACCELERATORS

46418 **(CONF-850504—Pt.1) IEEE Transactions on Nuclear Science. 1985 particle accelerator conference: accelerator engineering and technology. Volume NS-32, No. 5. Part 1.** Shea, R.F. (ed.). (Institute of Electrical and Electronics Engineers, Inc., New York (USA)). 1985. Contract FG02-85ER40238. 99p. Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piocataway, NJ 08854-4150. File Number TI86014309.

From Particle accelerator conference; Vancouver, Canada (13 May 1985).

Separate abstracts were prepared for 346 papers in the first part of these conference proceedings. Topics covered in this part include high-energy accelerators and colliders, particle sources, electrostatic accelerators, controls, instrumentation, and feedback,

beam dynamics, low-energy and intermediate-energy circular accelerators and rings. (LEW)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 45709

46419 **(BNL—34518-Ed.3) AGS experiments: 1984, 1985, 1986. Third edition.** Depken, J.C. (Brookhaven National Lab., Upton, NY (USA)). Feb 1986. Contract AC02-76CH00016. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86013378.

Brief summaries are given of 44 different experiments either running or scheduled to run at the Brookhaven National Laboratory Alternating Gradient Synchrotron, as well as the experiment schedules. The beam parameters and fluxes are tabulated. Illustrations are given of both the experimental area layouts and the apparatus for each experiment. (LEW)

46420 **(DOE/SF/00515—T65) Stanford Linear Accelerator Center monthly report for June 1986.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1986. Contract AC03-76SF00515. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014120.

Operational activities for the month of June 1986 are reported in the areas of accelerator and research operations, research area and experiment status, accelerator improvements, research division developments, PEP division developments, and publications for the month. (LEW)

46421 (LA—10655-C, pp 5-33) **Status of LAMPF.** Rosen, L. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

The status of the last year are reviewed. Topics covered include some major research advances, eg. muon decay, major facilities additions and operational milestones. Also discussed are the politics of LAMPF II and management issues.

46422 (LA—10655-C, pp 34-36) **Future directions.** Garvey, G.T. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

Present capabilities and future advances at LAMPF are briefly described. In the near term TOFI, the sophisticated magnetic spectrometer, will soon be on line for neutrino oscillation experiments and in the longer term the Nucleon Physic Laboratory will allow new nucleon-nucleon and nucleon-nucleus physics. LAMPF II will provide significant capability for investigations of deconfinement and the Standard Model.

46423 (LA—10655-C, pp 37-40) **Operation's report 1985 users meeting.** Hagerman, D.C. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

The past year has been extremely busy at LAMPF with the first half being devoted to a shutdown for major changes in the facility and the second half being devoted to production under the challenging conditions imposed by three-beam operation.

46424 (LA—10655-C, pp 124-130) **Japanese medium energy program.** Yamazaki, T. (Univ. of Tokyo, Japan). Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

Most of the present research activities on medium energy nuclear and particle physics in Japan are based on the proton synchrotron facilities at KEK (National Laboratory for High Energy Physics). The KEK PS complex consists of a 500 MeV rapid cycling booster synchrotron of 20 Hz repetition and a 12 GeV main ring. The design concept underlying was to facilitate parasitic use of the 500 MeV beam while accelerating protons to 12 GeV in the main ring, because the main ring requires only a quarter (9 pulses) of the booster beam in a cycle of 2.14 sec. After the successful operation of the KEK PS in 1975, three parasite projects using the booster beam were established. (i) A pulsed neutron scattering facility (KENS) for condensed matter research, (ii) a pulsed meson facility for meson science (BOOM), and (iii) a medical project using protons and neutrons. The author will talk about the meson science project at the booster synchrotron as well as various nuclear/particle programs at the 12 GeV PS, and at the end the author will mention future plans.

46425 **(LBL—21536) Future accelerator technology.** Sessler, A.M. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 10p. (CONF-860575—17). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013190.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A general discussion is presented of the acceleration of particles. Upon this foundation is built a categorization scheme into which all accelerators can be placed. Special attention is devoted to accelerators which employ a wake-field mechanism and a restricting theorem is examined. It is shown how the theorem may be circumvented. Comments are made on various acceleration schemes.

46426 **(LBL—21673) Relativistic heavy ion facilities: worldwide.** Schroeder, L.S. (Lawrence Berkeley Lab., CA (USA)). May 1986. Contract AC03-76SF00098. 24p. (CONF-860575—16). NTIS, PC AA02/MF A01; 1; GPO Dep. File Number DE86013009.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A review of relativistic heavy ion facilities which exist, are in a construction phase, or are on the drawing boards as proposals is presented. These facilities span the energy range from fixed target machines in the 1 to 2 GeV/nucleon regime, up to heavy ion colliders of 100 GeV/nucleon on 100 GeV/nucleon. In addition to specifying the general features of such machines, an outline of the central physics themes to be carried out at these facilities is given, along with a sampling of the detectors which will be used to extract the physics. 22 refs., 17 figs., 3 tabs.

46427 **(SAND—86-1722C) Radial transmission line linear accelerators.** Prestwich, K.R. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 42p. (CONF-860756—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013565.

From NATO advanced study institutes program conference; Pitlochry, Scotland (13 Jul 1986).

Very-high-current linear accelerators are discussed which can be built with either radial or coaxial filled with high dielectric strength liquids. These cavities function as pulse-forming transmission lines and as a means to supply energy to the beam. Cavity design considerations are discussed, particularly with respect to radial cavities and externally fed cavities. RADLAC I and LIU-10, two high-current electron beam accelerators operating with radial transmission, are described. Also described is RADLAC II, a 16 MV, 50 kA accelerator, which has been implemented using water dielectric strip transmission lines to supply energy to the beam. (LEW)

46428 **(SLAC-PUB—3936) SLAC low emittance accelerator test facility.** Loew, G.A.; Miller, R.H.; Sinclair, C.K. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 4p. (CONF-860629—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013435.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

SLAC is proposing to build a new Accelerator Test Facility (ATF) capable of producing a 50 MeV electron beam with an extremely low geometric tranverse emittance (1.5×10^{-10} rad.m) for the purpose of testing new methods of acceleration. The low emittance will be achieved by assembling a linear accelerator using one standard SLAC three-meter section and a 400 kV electron gun with a very small photocathode (40 microns in diameter). The pho-

tocathode will be illuminated from the back by short bursts (on the order of 6 ps) of visible laser light which will produce bunches of about 10^8 electrons. Higher currents could be obtained by illuminating the cathode from the front. The gun will be mounted directly against the accelerator section. Calculations show that in the absence of an rf buncher, injection of these 400 keV small radius electron bunches roughly 30° ahead of crest produces negligible transverse emittance growth due to radial rf forces. Acceleration of the electrons up to 50 MeV followed by collimation, energy slits and focusing will provide a 3.2 mm long waist of under 1.5 μm in diameter where laser acceleration and other techniques can be tested.

46429 (SLAC-PUB—3981) Unified formulation for linear accelerator design. Farkas, Z.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 7p. (CONF-860629—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013441.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Expressions for peak and average powers required to produce a given average gradient in an accelerator section are given. They are valid for both lossy and lossless (superconducting) sections, for both traveling wave and standing wave sections, and for pulsed or continuous wave rf input. The expressions are given in terms of structure parameters that are equally applicable to traveling wave or standing wave. These parameters delineate the effect of wall losses and energy required to build up the field. For both traveling wave and standing wave sections it is possible to make the rf pulse length short enough to make the wall losses negligible at the expense of increased peak power requirement. Therefore the expressions will include the effects of pulse compression. 6 refs., 7 figs.

46430 Short review of Monte Carlo hadronic cascade calculations in the multi-TeV energy region. Mokhov, N.V.; Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment*; **244**: No. 3, 349-355(1 Apr 1986).

Studies of a number of design problems of high energy proton accelerators are often carried out using Monte Carlo simulations of hadronic and electromagnetic cascades. This paper reviews results obtained using three computer programs which are compatible with the design problems of multi-TeV accelerators. Comparisons of the results obtained using these codes are made with each other and, where possible, with existing experimental data. Rather good agreement is typically found.

4302 Beam Dynamics, Field Calculations, And Ion Optics

46431 (AD-A—167631/1/XAB) Acceleration of ions and electrons by wave-particle interactions. Annual summary report, 1 April-30 November 1985. Wu, C.S.; Gaffey, J.D. (Maryland Univ., College Park (USA). Inst. for Physical Science and Technology). 30 Nov 1985. 10p. NTIS, PC A02/MF A01.

The research program is divided into four tasks. 1. Application of kinetic cross-field streaming instabilities to laboratory experiments. 2. Electromagnetic electron-cyclotron instability excited by hot electrons with a loss-cone distribution. 3. Induced emission of electromagnetic radiation near the second harmonic of the plasma frequency 4. Effects of an electrostatic instability on the induced emission of electromagnetic radiation near 2 omega sub e.

46432 (AD-A—167863/0/XAB) Acceleration of ions and electrons by wave-particle interactions. Final report for 1 April 1984-31 March 1985. Wu, C.S.; Gaffey, J.D. (Maryland Univ., College Park (USA). Inst. for Physical Science and Technology). 31 Mar 1985. 15p. NTIS, PC A02/MF A01.

This program studied instabilities resulting from energetic ion beams streaming across a magnetic field, or other nonequilibrium features, such as temperature anisotropy or a loss-cone distribution function, and calculating the emission of radiation at the fundamental and harmonics of the cyclotron frequency and at the second harmonic of the plasma frequency. The program has five tasks. 1. Effect of electron thermal anisotropy on the kinetic cross-field streaming instability. 2. Applications of kinetic cross-field streaming instabilities to laboratory experiments. 3. Electromagnetic electron-cyclotron instability excited by energetic electrons with a loss-cone distribution. 4. Induced emission of electromagnetic radiation near the second harmonic of the plasma frequency. Calculation of spontaneous cyclotron emissivity using the complete relativistic resonance condition.

46433 (CONF-860575—35) Possibility of achieving a condensed crystalline state in cooled particle beams. Schiffer, J.P.; Rahman, A. (Argonne National Lab., IL (USA); Minnesota Univ., Minneapolis (USA)). 1986. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014584.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Calculations have shown that when a plasma of one kind of particle (one-component plasma or OCP) is below a certain temperature, it will undergo a phase transition and the particles will form a crystalline (bcc) array. The relevant parameter is $\Gamma = (q^2/a)kT$ (where a is the average spacing and T the temperature) and the transition takes place at $\Gamma = 170$. the properties of proposed storage rings for heavy ions with $q >> e$, are such that an ordered array may actually be realized.

46434 (FNAL-TM—1407) Resonance scraping. Collins, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1986. Contract AC02-76CH03000. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014468.

Protons lost in a ring leave at a few preferred locations, determined by some non-linear property of the dipoles. This paper suggests taking control of lost protons by beating the magnets at their own game - by means of a designed resonance used as a beam scraper. It is a study of suitable resonances, including estimates of the required multipole element strengths. The appropriate resonances are two-dimensional. A large number of figures is included.

46435 (NAC—84-08) Test results of the signal processing and amplifier unit for the emittance measurement system. Stawiszynski, L.; Schneider, S. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703170.

The signal processing and amplifier unit for the emittance measurement system is the unit with which the beam current on the harp-wires and the slit is measured and converted to a digital output. Temperature effects are very critical at low currents and the purpose of the test measurements described in this report was mainly to establish the accuracy and repeatability of the measurements under the influence of temperature variations.

46436 (SAND—86-1539C) Ion focused transport experiments on Sandia's recirculating linac. Shope, S.L.; Tucker, W.K.; Bennett, L.F.; Finch, J.L.; Frost, C.A.; Hasti, D.E.; Kamin, G.W.; Miller, R.B.; Poukey, J.W.; Reinstra, W.W. (Sandia National Labs., Albuquerque, NM (USA); Science Applications International Corp., McLean, VA (USA)). 1986. Contract AC04-76DP00789. 6p. (CONF-8606153—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012944.

From DARPA conference; Albuquerque, NM, USA (23 Jun 1986).

Ion focused transport has been used to generate and transport a 1.2-MeV, 25-kA relativistic electron beam around a 90° curved sector. Low-energy electrons, confined and guided by a weak longitudinal magnetic field, were used to form the ionized channel in low pressure argon. The successful demonstration of beam bending is applicable to the Sandia Recirculating Linac. Initial experiments with the recirculating accelerator injector have demonstrated efficient generation and transport of a 1 MeV, 30 kA beam for more than a meter. 8 refs., 7 figs.

46437 **(SAND—86-1654C) Modeling WIPS tracking on RADLAC-II.** Freeman, J.R.; Marder, B.M.; Wagner, J.S. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 9p. (CONF-8606153—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014150.

From DARPA conference; Albuquerque, NM, USA (23 Jun 1986).

Computational modeling for the planned RADLAC-II WIPS tracking experiment is described. A cartesian version of the non-linear DYNADISC code has been developed and is being used for these studies.

46438 **(SLAC-PUB—3965) Radiation of a charge in a perfectly conducting cylindrical pipe with a jump in its cross section.** Kheifets, S.A.; Heifets, S.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 18p. (CONF-860629—30). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013438.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Electromagnetic fields of a point charge moving on the axis of an infinitely long straight cylindrical superconducting pipe with a sudden change of its cross section are found. The longitudinal coupling impedance of this structure is calculated. The method developed can be applied to some other geometries of interest.

46439 **(SLAC-PUB—3977) Beam dynamics, efficiency and power of the SLAC lasertron: simulation results.** Welch, J.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 4p. (CONF-860629—28). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013508.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Results are described for the computer simulation of the SLAC proof of principle lasertron device with a conventional single gap output cavity, using the 2D relativistic field and particle code called MASK. The rf to beam power efficiency is calculated for different power levels, dc voltages and optical pulse lengths. The calculated efficiency at the initial operating point of 50 MW beam power, 400 kV, and with 60 picosecond optical pulse duration, is 66%. The maximum rf power at 400 kV is about 50 MW. At 600 kV the maximum power increases to about 110 MW, but the efficiency at low power is not much changed from what it was at 400 kV. The simulation calculation does not take into account loss of rf power due to backscattered electrons nor the full effects of the impedance of the accelerating gap. A calculation of the efficiency of the lasertron with a double output cavity has been carried out, and generally yields efficiencies about 10 percentage points higher than the single cavity simulation.

46440 **(SLAC-PUB—3979) Beam-beam deflections as an interaction point diagnostic for the SLC.** Bambade, P.; Erickson, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 3p. (CONF-860629—35). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014087.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

A technique is described for non-destructive measurement and monitoring of the steering offset of the electron and positron beams at the interaction point of the SLC, based on using stripline beam-position monitors to measure the centroid of one beam as it is deflected by the opposing beam. This technique is also expected to provide diagnostic information related to the spot size of the micron-size beams.

46441 **(UCRL—93757) Misalignment of axial B-field in the advanced test accelerator.** Lauer, E.J.; Caporaso, G.J.; Prono, D.S.; Weir, J.T. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 3p. (CONF-860665—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013222.

From 6. international conference on high power particle beams; Kobe, Japan (9 Jun 1986).

The Advanced Test Accelerator (ATA) has solenoidal magnets to focus and guide the electron beam. The transverse position of the center of mass of the beam is measured at many positions along the accelerator using the wall current monitors. With the steering coils off, the beam drifts off axis a few cm in the length of the machine. The drift is independent of several parameters: field strength, beam current, and beam energy. Further measurements to locate the source of the misalignment will be discussed. 1 ref., 4 figs.

46442 **(UCRL—94348) Approaching maximal performance of longitudinal beam compression in induction accelerator drivers.** Mark, J.W.K.; Ho, D.D.M.; Brandon, S.T.; Chang, C.L.; Drobot, A.T.; Faltens, A.; Lee, E.P.; Krafft, G.A. (Lawrence Livermore National Lab., CA (USA); Science Applications International Corp., McLean, VA (USA); Lawrence Berkeley Lab., CA (USA); CEBAF, Newport News, VA (USA)). 27 May 1986. Contract AC03-76SF00098;W-7405-ENG-48. 10p. (CONF-860510—12). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014428.

From Symposium on heavy ion fusion; Washington, DC, USA (27 May 1986).

Longitudinal beam compression is an integral part of the US induction accelerator development effort for heavy ion fusion. Producing maximal performance for key accelerator components is an essential element of the effort to reduce driver costs. We outline here initial studies directed towards defining the limits of final beam compression including considerations such as: maximal available compression, effects of longitudinal dispersion and beam emittance, combining pulse-shaping with beam compression to reduce the total number of beam manipulations, etc. The use of higher ion charge state $Z \geq 3$ is likely to test the limits of the previously envisaged beam compression and final focus hardware. A more conservative approach is to use additional beamlets in final compression and focus. On the other end of the spectrum of choices, alternate approaches might consider new final focus with greater tolerances for systematic momentum and current variations. Development of such final focus concepts would also allow more compact (and hopefully cheaper) hardware packages where the previously separate processes of beam compression, pulse-shaping and final focus occur as partially combined and nearly concurrent beam manipulations.

46443 **(UCRL—94759) ATA operations.** Weir, J.T.; Caporaso, G.J.; Chambers, F.W.; Chong, Y.P.; Prono, D.S.; Rainer, F. (Lawrence Livermore National Lab., CA (USA)). 20 Jun 1986. Contract W-7405-ENG-48. 6p. (CONF-8606153—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013019.

From DARPA conference; Albuquerque, NM, USA (23 Jun 1986).

Four accelerator parameters were found to control the condition of the electron beam entering the Intergrated Fast Reactor (IFR). These parameters were the matching of the electron beam to the ion channel, the laser timing, the benzene pressure at the entrance to the IFR, and the timing of the accelerator gaps. Manipulation of these parameters make possible the control of the total current, the emittance, the pulse length, the mixture of laser induced current and cathode current, the radial growth in time, the final size of the beam, and the energy variation through the pulse. 1 fig.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 46605, 46606, 46633

46444 **(BNL—38310) BNL kaon beams, present and planned.** Lazarus, D.M. (Brookhaven National Lab., Upton, NY (USA). AGS Dept.). 1986. Contract AC02-76CH00016. 15p. (CONF-8606128—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014132.

From Production and transport of secondary beam at a kaon factory workshop; Vancouver, B.C., Canada (1 Jun 1986).

At the present time, there are three electrostatically purified (separated) kaon beams in operation at the Brookhaven AGS. They

are optimized for .8 GeV/c, 1.1 GeV/c and 6 GeV/c. A fourth beam has been designed for a maximum momentum of 2.0 GeV/c. It features two-stage purification and higher order optical corrections. Anticipated performance figures for the beam, which is capable of delivering more than 10^6 kaons per spill, are given, as well as measured performance figures for the existing beams. Possible purification schemes for momenta above 6 GeV/c are discussed. Performance data from neutral and unpurified beams are presented.

46445 (BNL—38387) Statistical and signal-processing concepts in surface metrology. Church, E.L.; Takacs, P.Z. (Army Research and Development Command, Dover, NJ (USA); Brookhaven National Lab., Upton, NY (USA)). Mar 1986. Contract AC02-76CH00016. 10p. (CONF-860366—10). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014176.

From SPIE technical symposium on applications of artificial intelligence; Orlando, FL, USA (31 Mar 1986).

This paper proposes the use of a simple two-scale model of surface roughness for testing and specifying the topographic figure and finish of synchrotron-radiation mirrors. In this approach the effects of figure and finish are described in terms of their slope distribution and power spectrum, respectively, which are then combined with the system point spread function to produce a composite image. The result can be used to predict mirror performance or to translate design requirements into manufacturing specifications. Pacing problems in this approach are the development of a practical long-trace slope-profiling instrument and realistic statistical models for figure and finish errors.

46446 (BNL—38398) Laser-Electron-Gamma-Source. Progress report, July 1986. Dowell, D.H.; Fineman, B.; Giordano, G.; Kistner, OC.; Matone, G.; Sandorfi, A.M.; Schaerf, C.; Thorn, C.E.; Ziegler, W. (Brookhaven National Lab., Upton, NY (USA)). Jul 1986. Contract AC02-76CH00016. 19p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013918.

When completed, the Laser Electron Gamma Source (LEGS) is expected to provide intense beams of monochromatic and polarized (circular or linear) gamma rays with energies up to 500 MeV. The gamma-ray beams will be produced by Compton backscattering uv laser light from the electrons circulating in a storage ring. Progress with installation of the facility is described, particularly the Ar-ion laser and tagging spectrometer. Tests of the tagging spectrometer coponents is reported, and a second laser is described for higher energy operation. Estimates are given of expected beam parameters. Experimental equipment for the planned research projects to be carried out at the LEGS facility is discussed. (LEW)

46447 (DOE/ER/10759—6) Operation, maintenance and upgrading of SUNY facilities at the National Synchrotron Light Source. Final report, 1 October 1980-31 May 1986. Prewitt, C.T. (State Univ. of New York, Stony Brook (USA). Research Foundation). 1986. Contract AC02-80ER10759. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013985.

A general facility is how operating and generating research results in x-ray scattering, diffraction, and spectroscopy. The contract just completed involved the construction and development of a single beamlines at NSLS subdivided to allow for diversity of experimental techniques. These include single-crystal diffraction at low temperatures and at high pressures, uhv surface studies using standing waves, time-resolved, small-angle scattering, and x-ray spectroscopy.

46448 (FNAL-TM—1406) Offset coil designs for superconducting magnets, a logical development. Collins, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1986. Contract AC02-76CH03000. 22p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014464.

Dipoles and quadrupoles for any new, large proton ring must be stronger, smaller and have better field shape (systematic error) than those used in the Doubler. The present two-shell designs are rigid in that the coils are too thin but cannot be relatively fatter without destroying the field quality. An examination of the coil shapes for dipoles and quadrupoles which produce perfect fields from a uniform current density shows clearly that our persistent use of a circular form for the inner surface of the coils is a poor approximation. When this is corrected by "offsets" there is a striking improvement both in the strength of fields and in the field quality. The same analysis makes clear that the efficient use of superconductor and the overall magnet size is determined by the perfect coil shapes. Any reasonable magnet will not differ significantly from the ideal for these parameters. This will be particularly helpful in setting design goals for very large quadrupoles. The offset two-shell dipole design preserves the mechanical features of the highly successful, resilient doubler magnets while greatly extending the performance.

46449 (FNAL-TM—1409) Sub-cooled liquid helium flow supply for design D magnet cooling at MDTF. Ohmori, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jul 1986. Contract AC02-76CH03000. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014463.

The parameters of the subcooled 4ATM helium flow from MTDF refrigerator and helium subcooler proposed to cool the SSC Design 'D' magnet is discussed. The system operating parameters are pressure - 4ATM and temperature - 4.35K. The higher than normal operating pressure is obtained by shutting down the cold turbine (T2) of MTDF refrigerator, and then not J-T the high pressure dense helium gas until after the magnet and liquid return line. The resultant helium temperature at the refrigerator outlet is described and the heat transfer tube length of the subcooler required to cool the flow to the ultimate desired temperature is evaluated.

46450 (INIS-mf—10408) KVI cyclotron: from injection to extraction. Asselt, W.K. van. (Rijksuniversiteit Groningen (Netherlands)). 15 Mar 1985. 88p. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703172.

The cyclotron at the KVI at Groningen (Netherlands) is a three-sector isochronous cyclotron for the acceleration of particles with different charge to mass ratios to a variable energy. In this thesis, a numerical study is presented with the aim to obtain a beam, which is well centred when it leaves the central region. 'Centring' in this respect implies that the mean position of the orbit centers is located within 1 mm with respect to the axis of the magnetic field. The application of field bumps for centring the beam has been studied and the influence of these bumps on the beam quality is described. Aspects of the acceleration process between the central region and the extraction radius are treated. An experimental study is given of the extraction process in which different beam loss mechanisms are diagnosed. Experiments with two different extraction systems are described. The operation of the cyclotron in combination with the axial injection system during the first half of 1984 is described. Includes Dutch summary; 47 refs.; 52 figs.; 5 tabs.

46451 (INS-J—169) Recent experimental results at Tokyo Electron Synchrotron. Kato, Sadayuki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Oct 1984. 37p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703169.

Completed in 1961, the electron synchrotron has been continually improved; it is now operated at 1.3 GeV with intensity 2.5 x 10^{13} electrons/sec. In the experimental area there are five beam channels, which are low intensity photons, breamsstrahlung photons, electrons, soft X-rays and fast extracted electrons. A storage ring is used in solid state physics; injection of electrons into the ring is made three times a day, being accelerated up to 400 Mev. Contents are the following: phenomenological analyses of pion photoproduction, photocouplings of $\gamma p \rightarrow \gamma p$ reaction, deutron photodisintegration, neutral pion photoproductions on deuteron, and the nucleon correlation in nuclei.

46452 **(KEK—84-13) Proceedings of the workshop on data acquisition system for high energy physics.** Hayano, R.S. (ed.). (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Sep 1984. 125p. (In Japanese). (CONF-8405417—Summs.). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703177.

From Workshop on data acquisition system for high energy physics; Ono, Ibaraki, Japan (28 May 1984).

The workshop "Data acquisition system for high energy experiment" was held by the on-line electronics group of KEK in cooperation with the data processing section on May 28-29, 1984, at KEK. This year, the proton synchrotron is prepared for the work after shutdown, and in the TRISTAN, the full scale construction of the data acquisition system is advanced. One of the large topics was the TKO box proposed by the data acquisition development group of KEK, and its specification is included in this book. This workshop was the meeting with very wide range from front end electronics to large computers. The talks on flash analog/digital converters and latest data communication were held. As a new trial, the wish lists on the future development and support of on-line electronics and others were collected from the participants, and these were deliberated by all the members. The contents of the discussion at this time are given in this book. The summaries of the lectures presented at the meeting are collected in this book. The interchange with the experimental group is indispensable for the activities of the on-line electronics group, accordingly, the workshop like this will be held hereafter.

46453 (LA—10655-C, pp 95-112) **NPL upgrade.** McClelland, J.B. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

LAMPF has embarked on a major three year development program to upgrade the Nucleon Physics Laboratory (NPL) to both enhance ongoing experimental programs and to provide facilities for new physics research in nucleon charge-exchange reactions. This talk concentrates on the new physics opportunities presented by this upgrade with a brief description of the experimental facilities.

46454 (LA—10655-C, pp 113-123) **WNR neutron source.** Lisowski, P.W. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

The Weapons Neutron Research (WNR) facility is a versatile pulsed neutron source used in a wide variety of research programs. In this talk the WNR Facility and the experimental program are described with emphasis on the potential of the WNR for studying nuclear physics issues.

46455 **(LA-UR—86-2388) Pulsed magnetic field for PHERMEX-injected circular accelerator.** Moir, D.C.; Ruhe, J.R.; Armstrong, W.T. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-860703—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013842.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

The PHERMEX accelerator is a standing wave, 50 MHz rf linear accelerator. The rf fields in three cavities are pulsed for a period of 3 ms. The experiments described are directed toward studying injection and trapping of electron rings at modes field strengths (approximately 1 T). A single 200 ns beam macropulse is to be injected transverse to a solenoidal field, which is tilted at a small angle relative to the beam normal so that a beam micropulse does not return and strike the injection point. The pulsed field coils and vacuum chamber are reported under construction, and the capacitor bank being tested. (LEW)

46456 **(NAC—83-02) Final magnetic shimming of vacuum chamber suspension holes on the sector magnets.** Bader, D.; Jungwirth, H.N. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703173.

The 48 holes in the pole faces of the sector magnets for suspending the vacuum chamber reduce the magnetic field locally. These field perturbations have been measured on 5M4 and the optimum thickness of the magnetic shims to be used for correcting them has been determined. The report mentions that the shimming of the magnetic field perturbations due to the vacuum chamber suspension holes in the pole faces was successful.

46457 **(NAC—83-03) Investigation of current setting procedures for sector magnets.** Bader, D. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1983. 6p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703174.

Because of the huge iron mass which must be magnetized when setting a field, it takes some time until the gap field settles. To cut the process down in time it is common practice to overshoot the set level by a few percent. The results of the measurements to find the optimum excess and overshooting time obtained so far are gathered in this report.

46458 **(NAC—83-07) Building of a prototype steering magnet.** Conradie, J.L.; Cornell, J.C. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1983. 12p. (In Afrikaans). NTIS (US Sales Only), PC A02/MF A01. File Number DE86703175.

The report deals with the building of a prototype magnet. The magnet is completely symmetrical, and consists of 4 identical pieces of iron, 167 x 80 x 15 mm each. Magnetic flux density for 4 different magnet coils is given. Information is also given on the magnetic fields and the bending ability of the field through which the particles are supposed to move. The magnet coils and the form of the yoke are described.

46459 **(NAC—83-08) Optimization of ion source positions in SPS1.** Burger, S.J. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1983. 17p. (In Afrikaans). NTIS (US Sales Only), PC A02/MF A01. File Number DE86703171.

After previous studies a 3:1 scale electrolytic tank model was designed for the determination of the form of electrical fields. Determinations of the fields showed that the determined position of the ion source did not deliver well-centered circuits. At this stage it was again decided to determine optimal positions for the ion sources. The results for calculations in the case of 8 MeV protons are supplied.

46460 **(NAC—84-15) Design of a sending magnet for the high energy beamline.** Conradie, J.L.; Fourie, D.T.; Cornell, J.C. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1984. 20p. (In Afrikaans). NTIS (US Sales Only), PC A02/MF A01. File Number DE86703176.

On the high energy beamline of the National Accelerator Centre the beam appeared to disregard the calculated path. To correct these deflections sending magnets will be used at various places on the beamline. Magnets for the external beamline were designed and a prototype was build to establish if it is functioning according to the specifications. Information on the following aspects is provided: specifications for the magnets; the determination of magnetic stiffness of 220 MeV protons; physical measurement of the magnets; magnetic pole pieces; the magnetic-motoric force needed for the maximum flux density; coil resistance and dimensions; magnetic fields and the stability of the power plant.

46461 (SLAC/AP—51) Some problems on rf breakdown in room temperature accelerator structure, a possible criterion. Wang, J.W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013386.

The discussion is confined to high gradient, room-temperature accelerators which have clean well-finished cavity surfaces and good vacuum conditions. Breakdown-initiating mechanisms due to "cold" field electron emission occurring at isolated sites on broad-area cavity surfaces, where the field is enhanced, are described. The influences of an alternating field and transition time tunneling are taken into account. The thermal instability resulting in vacuum voltage breakdown is hypothesized to derive a new criterion for room-temperature accelerator structure. 18 refs., 5 figs. (DWL)

46462 (SLAC-CN—334) Master oscillator stability requirements considerations. Schwarz, H.; Vancraeynest, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 24 Jun 1986. Contract AC03-76SF00515. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014118.

This note attempts to point out some ideas about the required stability of the 476 MHz master oscillator, assuming that the phase noise of the oscillator is the only source of noise in the accelerator system.

46463 (SLAC-PUB—3945) SLC energy spectrum monitor using synchrotron radiation. Seeman, J.; Brunk, W.; Early, R.; Ross, M.; Tillmann, E.; Walz, D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 4p. (CONF-860629—34). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013507.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

The SLAC Linac is being upgraded for the use in the SLAC Linear Collider (SLC). The improved Linac must accelerate electron and positron bunches from 1.2 GeV to 50 GeV while producing output energy spectra of about 0.2%. The energy spectra must be maintained during operation to provide for good beam transmission and to minimize chromatic effects in the SLC ARCs and Final Focus. the energy spectra of these beams are determined by the bunch length and intensity, the RF phase and waveform and the intra-bunch longitudinal wakefields. A non-destructive energy spectrum monitor has been designed using a vertical wiggler magnet located downstream of the horizontal beam splitter at the end of the SLC Linac. It produces synchrotron radiation which is viewed in an off-axis x-ray position sensitive detector. The expected resolution is 0.08%. The design considerations of this monitor are presented in this paper. A pair of these monitors is under construction with an installation date set for late summer 1986. 5 refs., 6 figs.

46464 Multiwire secondary emission beam profile monitor with 20 μm resolution. Krider, J.; Hojvat, C. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Instruments and Methods in Physics Research;* **247**: No. 2, 304-308(15 Jun 1986).

A 20 μm resolution multiwire beam profile monitor has been designed for the Fermilab antiproton source. The monitor consists of closely packed wires operating by secondary emission (SEM).

46465 Increasing the energy of SLC by transient wake field. Yao, C.G.; Ecklund, S. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Instruments and Methods in Physics Research;* **247**: No. 2, 301-303(15 Jun 1986). Contract AC03-76SF00515.

Also published as report SLAC-CN--306.

This paper describes a way to make use of the field excited by the beam in the disk-loaded waveguide combined with the RF field in phase, to increase the output energy of the linear accelerator at the expense of beam duty cycle. Actually, the whole facility can be operated with both a Linac and storage rings.

46466 Optically pulsed electron accelerator. Fraser, J.S.; Sheffield, R.L. (to Dept. of Energy). US Patent Application 6-736,033. 20 May 1985. 14p. Contract W-7405-ENG-36. DE86013719 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013719.

An optically pulsed electron accelerator can be used as an injector for a free electron laser and comprises a pulsed light source, such as a laser, for providing discrete incident light pulses. A photoemissive electron source emits electron bursts having the same duration as the incident light pulses when impinged upon by same. The photoemissive electron source is located on an inside wall of a radiofrequency-powered accelerator cell which accelerates the electron burst emitted by the photoemissive electron source.

46467 Versatile monochromator for synchrotron x-rays. Staudenmann, J.L.; Sandholm, M.; Chapman, L.D.; Liedl, G.L. (Ames Lab., IA). *Nuclear Instruments and Methods in Physics Research;* **222**: 177-179(1984). Contract W-7405-ENG-82;AC02-80ER10744.

A versatile fixed exit double monochromator system was designed and constructed for NSLS to provide full flexibility in the selection of high energy X-ray photons for X-ray scattering experiments. The system is designed for operation in a helium atmosphere with beryllium window isolation. A water cooled tantalum slit which opens symmetrically is included to allow a horizontal beam of 8 mrad (~ 100 mm wide white beam) at 12 m from the source. A variety of focusing devices and crystals can be mounted onto each goniometer. The system will allow a Bragg angle range from 3.5 to 86.5° and the independent control provides the opportunity for the low dispersive (mixed crystals) as well as the standard non-dispersive arrangement. 11 references, 1 figure.

4304 Storage Rings

REFER ALSO TO CITATION(S) 46434

46468 (ANL—85-22, pp 18-20) Feasibility study of electron-scattering experiments with a tensor-polarized deuterium target in an electron storage ring. Holt, R.J.; Geesaman, D.F.; Goodman, L.S.; Green, M.; Kowalczyk, R.; Napolitano, J.; Peshkin, M.; Ungricht, E.; Young, L.; Zeidman, B. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The feasibility of using a spin-exchange optical-pumping method to produce a high flux of tensor-polarized deuterium atoms is being tested. In this method, alkali atoms are polarized by optical pumping and the polarization is transferred to deuterium by successive spin-exchange collisions. In a test with a simple model the authors achieved 10 mW of laser power absorbed to the spin-exchange process with deuterium. Construction of a more sophisticated prototype was completed and tests are in progress. Dissociation fractions in excess of 80% for deuterium molecules have been achieved thus far. In order to optimize the performance of the prototype target, a computerized model of the target was constructed. A section of a differential-pumping system was constructed and tested. It was possible to sustain more than the required 5 orders-of-magnitude pressure drop in a distance of approximately 1.5 m.

46469 (CONF-860575—20) Storage rings for heavy-ion atomic and nuclear physics. Young, G.R. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013343.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief review is given of the physics goals and a few of the accelerator physics issues relevant to the new generation of small storage rings being built for atomic and nuclear physics use.

44 INSTRUMENTATION

REFER ALSO TO CITATION(S) 46396

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 46274, 46616, 47003, 47010

46470 **(AD-A—167381/3/XAB) Detection of alpha-particle interactions using the track-etch technique. Master's thesis.** Myers, R.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Mar 1985. 68p. NTIS MF A01.

In this thesis the author developed and set up experimental procedures and methodologies for detection of low-energy alpha particles using the track-etch technique. Three track-etch materials, lexan polycarbonate, cellulose nitrate, and CR-39, were exposed to various-energy alpha particles. The exposure resulted in the formation of atomic-scale damage tracks within each material. Because the damage tracks were on an atomic scale in size, they could not be optically seen unless enhanced or enlarged by some physical means. Three methods of enhancement were performed on the exposed track-etch materials. These methods were chemical etching, electrochemical etching, and a combination of the two. The results indicted that all three etching methods provided adequate enhancement of the alpha damage tracks, thereby showing that low-energy charged particles can be detected using the track-etch technique.

46471 **(AERE-R—11694) Sources of series resistance in the Harwell solid state alpha detector.** Rawlings, K.J. (UKAEA Atomic Energy Research Establishment, Harwell. Instrumentation and Applied Physics Div.). Dec 1985. 17p. H.M. Stationery Office, London, price Pound 4.00.

The metal-semiconductor contacts to the Harwell solid state alpha detector have been characterized and the effect of the contact geometry has been assessed. To a reasonable approximation the latter gives rise to an emitter series resistance with an expected range of 20 +- 8 ohms. The contacts behave like parallel RC networks which become noticeably frequency dependent above ca. 100 kHz. Up to this frequency the emitter contact is likely to add 6 +- 4 ohms to the series resistance and the contribution from the base contact varies inversely with the square of the diode's diameter, being 5 +- 3 ohms for a diode with a diameter of 30 mm.

46472 **(AERE-R—11926) Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.** Harrison, K.G. (ed.). (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Aug 1985. 43p. H.M. Stationery Office, London, price Pound 5.00.

A report is given of an intercomparison exercise on personnel neutron dosemeters based on proton-sensitive track detectors. The report consists of nine brief papers describing the dosemeters used and the results obtained by each of the participants. The background (in terms of dose equivalent from normally incident AmLi neutrons) is given for 11 measurements for exposure to 4.56mSv AmLi neutrons as well as the standard deviation in the background. All nine papers were indexed separately.

46473 (AERE-R—11926, pp 1-3) **NRPB neutron personal dosemeter: dependence of response on neutron energy.** Bartlett, D.T.; Steele, J.D. (National Radiological Protection Board, Chilton, UK). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of a dosemeter pack used in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive tract detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46474 (AERE-R—11926, pp 5-11) **Results of CENDOS CR-39 neutron irradiations.** Civolani, O.; Lembo, L. (ENEA, Bologna, Italy Lab. Applicazioni di Dosimetria). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of two types of neutron dosemeters used in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46475 (AERE-R—11926, pp 13-16) **Intercomparison of neutron irradiations (CR-39 dosemeters).** Decossas, J.L.; Varceille, J.C. (Limoges Univ., France. Lab. d'Electronique des Polymeres sous Faisceaux Ioniques). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of two types of neutron dosemeters used in an intercomparison exercise on personnel dosemeters based on proton sensitive track detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46476 (AERE-R—11926, pp 17-20) **Summary of results obtained at AERE using electrochemical etching of commercial grade CR-39.** Haigh, R.M.; Harrison, K.G. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of the use of CR-39 in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter senstitivities.

46477 (AERE-R—11926, pp 21-24) **Summary of results obtained at AERE using electrochemical etching of Bristol University CR-39.** Harrison, K.G.; Haigh, R.M. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of the use of CR-39 in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. The CR-39 sheet was manufactured at the University of Bristol and comparisons of its performance are made with commercially available CR-39. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46478 (AERE-R—11926, pp 25-30) **CENDOS joint neutron irradiation exercise - results from Berkeley Nuclear Laboratories.** Harvey, J.R.; Weeks, A.R. (Central Electricity Generating Board, Berkeley, UK. Berkeley Nuclear Labs.). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of the use of CR-39 in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities. A description is also given of the reading system used which consists of a videcon tube, television monitor and image analysis system.

46479 (AERE-R—11926, pp 31-34) **Response of electrochemically etched Kodak CN85 track detector to neutrons.** Medioni, R.; Spurny, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92, France). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of four detectors used in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. The detectors used all consisted of KODAK CN85 cellulose nitrate but with different coverings or radiators, Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46480 (AERE-R—11926, pp 35-36) **CENDOS neutron irradiation of Bristol CR-39.** Worley, A.; Fews, A.P.; Henshaw, D.L.; Portwood, T.; Turner, T.W. (Bristol Univ., UK. H.H. Wills Physics Lab.). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of two CR-39 dosemeters used in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46481 (AERE-R—11926, pp 37-39) **Intercomparison data (CR 39 detectors).** Tommasino, L.; Zapparoli, G. (ENEA, Casaccia, Italy. Centro Ricerche Energia). Aug 1985. H.M. Stationery Office, London, price Pound 5.00.

In Neutron irradiations of proton-sensitive track detectors: results of a joint irradiation organised by CENDOS.

A brief description is given of the use of CR-39 in an intercomparison exercise on personnel neutron dosemeters based on proton sensitive track detectors. A boron radiator (for thermal neutrons) and a polythene radiator (for fast neutrons) were used. Details of the etching, assessment and results are presented and discussed in terms of measured dosemeter sensitivities.

46482 (ANL—85-22, pp 13-15) **Focal-plane detector for 1.6-GeV spectrometer at SLAC.** Geesaman, D.F.; Green, M.C.; Holt, R.J.; Jackson, H.E.; Kowalczyk, R.S.; Zeidman, B.; Thornton, S.T. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

In order to perform experiment NE-1 and NE-5 at SLAC, it is necessary to construct a new focal-plane detector assembly for the 1.6-GeV spectrometer. The authors have been requested to provide a general-purpose system suitable or easily changed for detection of electrons or hadrons. In collaboration with the University of Virginia group, the authors are in the process of constructing the detector.

46483 (ANL—85-22, pp 38-39) **Weak magnetism effects in beta spectra.** Camp, J.; Garvey, G.T.; Wark, D. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

A flat-field beta spectrometer with active collimation and a 3-wire detector with ray-tracing capability to permit background rejection has been built. It is intended to use this system to observe the effect of weak magnetism on beta decay spectra. Previous experimental attempts to measure this effect have proven very difficult because of the small size of the effect, the order of 1% per MeV deviation from the allowed shape. The development of the spectrometer has involved two main thrusts. First, the wire detector requires 1% position resolution in 2 dimensions to be sensitive to multiple scattering and background events. Second, the low acceptance of the spectrometer necessitates very high target yields.

46484 (ANL-HEP-CP—86-32) **First events and prospects at the Fermilab collider.** Binkley, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1986. Contract W-31-109-ENG-38. 21p. (CONF-860150—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014604.

From Winter condensed matter physics conference: frontiers in condensed matter X-ray physics; Aspen, CO, USA (12 Jan 1986).

A brief description of the Collider Detector at Fermilab (CDF) is given including the detector components and the data acquisition system. The first test run, the first events, and the performance of the detector are discussed. Finally the prospects for future running are reviewed.

46485 (BNL—38229) **Large solid angle tracking of Monte Carlo events of heavy ion collisions in TPC magnetic spectrometers.** Lindenbaum, S.J.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Asoka-Kumar, P.P.V. (Brookhaven National Lab., Upton, NY (USA); City Coll., New York (USA)). 1986. Contract AC02-76CH00016. 12p. (CONF-860441—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014137.

From 5. international conference on ultra-relativistic nucleus-nucleus collisions (Quark Matter '86); Pacific Grove, CA, USA (13 Apr 1986).

The collision of 15 GeV/nucleon sulfur and carbon or oxygen ions with various fixed targets such as carbon, sulfur, and gold is to be observed in the MPS magnetic spectrometer with a time projection chamber (TPC) module. This TPC will be placed just downstream of the target and be able to track approximately 50% of all charged particles. The design and construction of the TPC is proceeding, and prototypes of the TPC readout system have been tested and production devices are to be delivered. A TPC track reconstruction program has been developed. Monte Carlo events have been generated and tracked. The track reconstruction program consists of three parts: a local pattern recognition which associates contiguous readouts on adjacent readout wires to form a single hit; a subroutine which positions the hits into slices in the vertical plane; and the track reconstruction section. (LEW)

46486 (CONF-8604103—1) **CCD-based parallel detection system for electron energy-loss spectrometry and imaging.** Strauss, M.G.; Naday, I.; Sherman, I.S.; Zaluzec, N.J. (Argonne National Lab., IL (USA)). Apr 1986. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014579.

From Conference on frontiers of electron microscopy in materials science; Argonne, IL, USA (21 Apr 1986).

A generic, 2-dimensional integrating detector based on a charge-coupled device (CCD) is being developed for applications in physical and biomedical research. A detector system, operating in a 1-dimensional mode, is currently being designed for electron energy-loss spectroscopy (EELS); when operated in a 2-dimensional mode it is suitable for electron imaging studies. An energy-loss spectrometer (Gatan 607) is being equipped with a magnifying quadrupole electron lens to produce an electron dispersion of ~15 mm on a YAG:Ce scintillator. The scintillation light is coupled via an optical lens system to a 512 pixel x 512 pixel CCD. Energy-loss spectra are recorded successively in 5 pixel x 512 pixel frames. With a microscope beam current of 0.5 nAmp and electron energy of 120 keV, the integration (exposure) time for 100 frames is 40 msec and the readout and digitization time for 100 frames, using a 14-bit ADC, is 0.5 sec. The statistical precision expected by summing the 100 frames in the computer is 10^{-4} for the zero-loss peak (DQE = 0.4). For a peak of 1/1000 the intensity of the zero-loss peak, the precision is 10^{-2} (DQE = 0.2). To obtain the same precision (10^{-2}) with a 512-pixel linear photodiode array would require data from at least 280 frames and an acquisition time 35 to 70 times longer than the 40 msec required for the exposure of 100 frames in the CCD.

46487 (ECN—181) **International comparison of interpolation procedures for the efficiency of germanium gamma-ray spectrometers (GAM83 exercise).** Zijp, W.L.; Polle, A.N.; Nolthenius, H.J. (Netherlands Energy Research Foundation, Petten). Jan 1986. 83p. (ICRM-S—13). NTIS (US Sales Only), PC A05/MF A01. File Number DE86703197.

Results are presented for the outcome of an international intercomparison of a particular gamma-ray spectrometric procedure. Laboratories were asked to determine full energy peak efficiencies and activities by means of their own procedures, starting from supplied peak-efficiency data. Four data sets for four different conditions of germanium detectors were distributed. The sets comprised: a high accuracy- (uncertainty > 1%) data set with a relatively large number of measured data (SET 1); a low accuracy- (uncertainty 3-5%) data set with a relatively small number of measured data (SET 2); a low energy-data set (SET 3); a high accuracy-data set with a relatively small number of measured data (SET 4). The intercomparison (coded GAM83) was organized and analyzed under auspices of the International Committee for Radionuclide Metrology (ICRM). The results comprise the analysis of the contributions of 41 participants. 40 figs.; 32 refs.; 19 tables.

46488 (EGG-M—08185) **Nuclide activities determined from gamma-ray spectra from Ge detectors: a review with GAUSS VIII as the example.** Helmer, R.G.; Putnam, M.H.; McCullagh, C.M. (EG and G Idaho, Inc., Idaho Falls (USA)). 1985. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013341.

Various features are described that are useful in a general-purpose computer program to analyze gamma spectra from Ge detectors. An INEL code, GAUSS VIII, is used as an example of such a program. The discussion assumes that the goal of the analysis is to determine the activities of the nuclides present for a number of spectra (i.e., production analysis) and that no specialized treatment is given to any particular spectrum. 17 refs., 7 figs., 1 tab.

46489 (INIS-mf—10173) **Wire chamber conference.** Bartl, W.; Neuhofer, G.; Regler, M. (eds.). (Technische Univ., Vienna (Austria)). Feb 1986. 93p. (CONF-860272—Absts.). NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196.

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

This booklet contains program and the abstracts of the papers presented at the conference, most of them dealing with performance testing of various types of wire chambers. The publication of proceedings is planned as a special issue of 'Nuclear instruments and methods' later on. All abstracts are in English. An author index for the book of abstracts is given.

46490 (INIS-mf—10173, pp 27) **Parallel electrode position sensitive detector system for high counting rates.** Hendrix, J. (European Molecular Biology Laboratory, Hamburg, Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46491 (INIS-mf—10173, pp 25) **Detection of high energy cosmic nuclei on the space shuttle.** Mueller, D. (Chicago Univ., IL, USA. Enrico Fermi Inst.; Chicago Univ., IL, USA. Dept. of Physics). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46492 (INIS-mf—10173, pp 25) **Use of wire chambers in structural biology.** Schoenborn, B.P.; Schefer, J.; Schneider, D.K. (Brookhaven National Lab., Upton, NY, USA). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46493 (INIS-mf—10173, pp 26) **High count rate position-sensitive detectors for synchrotron radiation experiments.** Hasegawa, K.; Mochiki, K.; Koike, M.; Satow, Y.; Hashizume, H.; Iitaka, Y. (Tokyo Univ., Japan. Faculty of Engineering; KEK, Tsukuba, Japan; Tokyo Inst. of Tech., Japan; Tokyo Univ., Japan. Faculty of Pharmaceutical Sciences). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46494 (INIS-mf—10173, pp 28) **Pulse shape analysis for a jet chamber with long drift path in the presence of magnetic fields.** Mayer, H.-J.; Bittner, S.; Ludwig, J.; Sverko, I.; Weltin, A.; Schaile, D.; Schaile, O. (Freiburg Univ., Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46495 (INIS-mf—10173, pp 28) **OPAL jet chamber full size prototype.** Schaile, D. (Freiburg Univ., Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46496 (INIS-mf—10173, pp 29) **Time expansion chamber as vertex detector for experiment MARK J at DESY.** Viertel, G. (Eidgenoessische Technische Hochschule, Zurich, Switzerland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46497 (INIS-mf—10173, pp 30) **New drift chamber for the Mark II detector at the SLAC linear collider.** Hanson, G.G. (SLAC Stanford, USA). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46498 (INIS-mf—10173, pp 31) **Modular multidrift vertex detector.** Sauli, F.; Bouclier, R.; Charpak, G.; Mine, P.; Peisert, A.; Ropelewski, L.; Santiard, J.C.; Solomey, N. (European Organization for Nuclear Research, Geneva, Switzerland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46499 (INIS-mf—10173, pp 31) **Induction drift chamber.** Roderburg, E.; Baecker, A.; Krieger, H.; Mattern, D.; Walenta, A.H. (Siegen Univ., Gesamthochschule, Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46500 (INIS-mf—10173, pp 32) **Detection of charged particles in amorphous silicon layers.** Perez-Mendez, V.; Kaplan, S.N.; Morel, J.; Street, R.; Ward, W. (Lawrence Berkeley Lab., CA, USA). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46501 (INIS-mf—10173, pp 32) **Multisectional wire chamber for investigation of impulse X-ray and VUV plasma radiation.** Peskov, V.D. (Institute for Physical Problems, Moscow, USSR). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46502 (INIS-mf—10173, pp 34) **Results from half-scale DELPHI TPC prototype tests.** Vilanova, D. (CERN-College de France-orsay-Saclay, France). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46503 (INIS-mf—10173, pp 35) **Measurement of avalanche broadening caused by the wire E x B effect.** Blum, W.; Stiegler, U.; Gondolo, P.; Rolandi, L. (Max-Planck Institut, Muenchen, Germany, F.R.; Trieste Univ., Italy; Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46504 (INIS-mf—10173, pp 38) **Experience with the ASTERIX spiral projection chamber at LEAR.** Gastaldi, U. (European Organization for Nuclear Research, Geneva, Switzerland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46505 (INIS-mf—10173, pp 39) **Electron identification up to 100 GeV by means of transition radiation.** Nann, S.; Butt, H.J.; Koppitz, B.; Staa, R. van. (Hamburg Univ., Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46506 (INIS-mf—10173, pp 39) **Drift chamber for CMD-2 detector at VEPP-2M.** Khazin, B.I.; Aulchenko, V.M.; Snopkov, I.G.; Solodov, E.P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46507 (INIS-mf—10173, pp 40) **Time projection chambers and similar devices.** Nygren, D.R. (Lawrence Berkeley Lab., CA, USA). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46508 (INIS-mf—10173, pp 40) **Detector calibration and alignment with lasers.** Hilke, H.J. (European Organization for Nuclear Research, Geneva, Switzerland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46509 (INIS-mf—10173, pp 41) **Tracking systems of the collider detector at Fermilab.** Atac, M. (FNAL Batavia, USA). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

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46574 (INIS-mf—10174, pp XV/91) **Laboratory of routine alpha-spectrometry based on gridded ionisation chambers.** Saro, S.; Pikna, M. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46575 (INIS-mf—10174, pp XV/92) **Impulse ionization chamber for spectrometry of low-level alpha-activities and fission products.** Atanassov, D.; Dimchev, T. (National Laboratory for Metrology of Ionizing Radiations, Lovech, Bulgaria; Vissh Minno-Geolozhki Inst., Sofia, Bulgaria). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46576 (INIS-mf—10174, pp XV/93) **Shielding material for low-activity gamma-spectrometry.** Malatova, I.; Bucina, I.; Hulka, J.; Kolinsky, F.; Dolenek, J. (Institut Hygieny a Epidemiologie, Prague, Czechoslovakia; Vitkovicke Zelezarny Klementa Gottwalda, Ostrava, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46577 (INIS-mf—10174, pp XV/94) **Optimization of an anticompton spectrometer for the analysis of biological samples.** Klucke, H.; Beetz, J. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin, German Democratic Republic). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46578 (INIS-mf—10174, pp XVIII/109) **Sensitive monitoring of rented radioactive aerosols.** Malatova, I.; Bucina, I.; Mala, H.; Rulik, P.; Kuca, P.; Hodik, F.; Feik, K.; Sandrik, S. (Institut Hygieny a Epidemiologie, Prague, Czechoslovakia; Atomova Elektraren Bohunice, Jaslovske Bohunice, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46579 (INIS-mf—10174) **Low radioactivities '85. (The 7th Nuclear Science Colloquium). Program and abstracts.** (Komenskeho Univ., Bratislava (Czechoslovakia). Matematicko-Fyzikalna Fakulta). 1985. 147p. (CONF-8510205—Absts.). NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198.

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

The conference proceedings contain 108 papers. The following topics are dealt with: accelerator mass spectroscopy, rare decays, underground laboratories, low level counting and spectroscopy, double beta-decay experiments, low level detectors, cosmogenic radionuclides and rare events, ^{14}C counting and applications, ^{3}H counting and hydrology applications, natural radioactivity in the environment, gaseous detectors, anthropogenic radionuclides and radioactivity in the environment.

46580 (INIS-mf—10174, pp IV/8) **10 years low level counting in the underground laboratory in Bern, Switzerland.** Loosli, H.H.; Moell, M.; Oeschger, H.; Schotterr, U. (Bern Univ., Switzerland. Physikalisches Inst.). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46581 (INIS-mf—10174, pp IV/10) **Low backround underground laboratory for radiochemical research.** Surkov, Yu.A.; Sobornov, O.P. (AN SSSR, Moscow. Inst. Geokhimii i Analiticheskoj Khimii). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46582 (INIS-mf—10174, pp IV/11) **Preliminary results of the underground laboratory in Freiberg, GDR .** Hebert, D.; Froelich, K.; Franke, Th.; Gellermann, R. (Bergakademie Freiberg, German Democratic Republic. Sektion Physik). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46583 (INIS-mf—10174, pp V/13) **New frontiers in low-radioactivity physics.** Povinec, P. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46584 (INIS-mf—10174, pp V/14) **New low-level laboratory of the "Bundesversuchs- und Forschungsanstalt Arsenal, Wien".** Aiginger, H.; Unfried, E.; Maringer, F.; Rank, D. (Atominstitut der Oesterreichischen Universitaeten, Vienna; Bundesversuchs- und Forschungsanstalt Arsenal, Vienna, Austria). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46585 (INIS-mf—10174, pp V/15) **Background components of germanium and NaI(Tl) low level spectrometers.** Heusser, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany, F.R.). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46586 (INIS-mf—10174, pp VI/18) **Some remarks on statistical measures of lower limit of detection.** Bucina, I.; Malatova, I. (Institut Hygieny a Epidemiologie, Prague, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46587 (INIS-mf—10174, pp VI/19) **Outliers rejection as a method of long-term stability of short-term instabilities inspection in low radioactivities measurements.** Walanus, A. (Politechnika Slaska, Gliwice, Poland. Inst. Fizyki). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46588 (INIS-mf—10174, pp VI/20) **Statistical estimations for predicting the detection limit of low activities.** Dimchev, T. (Vissh Minno-Geolozhki Inst., Sofia, Bulgaria). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46589 (INIS-mf—10174, pp VI/21) **Proportional needle counter.** Kowalski, T.Z.; Ostrovski, K.W.; Zajac, J. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46590 (INIS-mf—10174, pp VI/22) **Contribution to the multiwire corona counters theory.** Holy, K.; Geze, J.; Oravec, J. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46591 (INIS-mf—10174, pp VI/23) **Pulse shape analysis in multiwire proportional chamber.** Kvetan, K.; Oravec, J. (Faculty of Machine Engineering, Department of Physics, Trnava, Czechoslovakia; Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46592 (INIS-mf—10174, pp VI/24) **Parametrization of gas gain in proportional counter for low radioactivities measurements.** Kowalski, T.Z.; Ostrowski, K.W.; Zajac, J. (Uniwersytet Adama Mickiewicza, Poznan, Poland. Inst. Fizyki). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46593 (INIS-mf—10174, pp VI/25) **Low matter density cylindrical proportional chambers.** Filippov, A.I.; Fursov, A.P.; Korenchenko, A.S.; Korenchenko, S.M.; Kravchuk, N.P.; Nekrasov, K.G.; Vanko, J. (Joint Inst. for Nuclear Research, Dubna, USSR). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46594 (INIS-mf—10174, pp VI/26) **Microcomputer based electronics for multielement proportional chambers.** Plesko, M. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46595 (INIS-mf—10174, pp VI/27) **Complex of scintillation equipments for high-precision measurements of radiocarbon abundance.** Metskhvarishvili, R.Ya.; Tsereteli, S.L.; Kocharov, G.E. (Tbilisskij Gosudarstvennyj Univ., USSR; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46596 (INIS-mf—10174, pp VI/28) **Accurate absorption technique for liquid scintillation measurement of carbon-14 in natural waters.** Yanev, Ya.L.; Kostadinov, K.N.; Chapkinova, G.T. (Sofia Univ., Bulgaria. Khimicheski Fakultet). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Abstr.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46597 (INIS-mf—10174, pp VI/29) **Influence of quenching effects to the scintillation efficiency of alpha- and beta-particles.** Schaefer, I. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden, German Democratic Republic). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Abstr.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46598 (INIS-mf—10174, pp VIII/33) **Design considerations of germanium detectors for very low level counting.** Helms, H.A. (PGT Princeton Gamma Tech Europa GmbH, Wiesbaden, Germany, F.R.). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Abstr.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46599 (INIS-mf—10174, pp VIII/34) **Use of BGO in low level spectroscopy.** Nes, P. van. (Harshaw Chemie B.V., De Meern, Netherlands). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Abstr.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46600 (KAPL—4193) **Improved set of Auger data analysis programs for physical electronics Auger spectrometer systems.** Mulford, R.A.; Austin, F.S.; Merchant, R.W. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Mar 1986. Contract AC12-76SN00052. 46p. (CONF-860829—33). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86009673.

From Annual joint meeting of the Electron Microscopy of America and the Microbeam Analysis Society; Albuquerque, NM, USA (10 Aug 1986).

This report describes a set of utility programs for the display and analysis of Auger spectral data collected with Physical Electronics (PHI) Auger Spectrometers using the embedded computer data acquisition system that is standard on PHI spectrometers. These programs are designed to replace the routines supplied by the manufacturer and offer the user greater flexibility. All routines will run on standard PHI systems equipped with HP2648 or HP2623 computer terminals. The major feature of these programs is the "windowing" capability for quantitative analysis of a list of elements. Spectra are collected and saved to disk using the PHI acquisition system in the usual fashion, except that it is not necessary to specify the elements that are present before the analysis is performed. The spectrum can be divided into any convenient arrangement of energy regions. This procedure permits the energy regions for data acquisition to be larger than the element windows to minimize the effect of the end points on the numerical differentiation. It is also easier to analyze closely spaced peaks, such as oxygen and chromium. When the spectra are processed, each region is automatically differentiated and displayed in sequence, with the energy windows for the Auger peaks marked in reverse video. Window limits can be moved easily, and multiple files can be analyzed using one setup. Results are stored on disk, together with the raw peak-to-peak heights and the sensitivity factors used. These disk files can then be read by simple auxiliary programs to average or tabulate results. 3 refs., 1 fig.

46601 (LA-UR—86-2413) **Fast, simple dB/dt probe.** Toevs, J.W.; Kruse, P.J.; Freeman, B.L. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860703—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013838.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

A simple dB/dt detector has been developed for monitoring fast current pulses in hostile environments. The detector consists of semirigid coaxial cable, which has been terminated by bending the center conductor back onto the shield and soldering it to the shield. Calibration with the beam from an electron linac has shown the integrated FWHM response to the electron-beam pulse to be less than 50 picoseconds. Measurements in a differential mode in a high radiation field have indicated that the sensitivity to gamma radiation is about 10^{-16} A/rad/s. An application of the probe is to determine gamma-ray fluxes from underground nuclear tests by measurement of Compton currents generated in a thin plate by the gamma rays.

46602 (LA-UR—86-2590) **Cygnus experiment at Los Alamos.** Dingus, B.L.; Goodman, J.A.; Gupta, S.K.; Talaga, R.L.; Chang, C.Y.; Yodh, G.B.; Bolton, R.D.; Burman, R.L.; Butterfield, K.B.; Cady, R. (Maryland Univ., College Park (USA); Los Alamos National Lab., NM (USA); George Mason Univ., Fairfax, VA (USA); New Mexico Univ., Albuquerque (USA); California Univ., Irvine (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-8606182—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013825.

From 5. international school of cosmic ray astrophysics; Erice, Italy (1 Jun 1986).

The Cygnus experiment at Los Alamos National Laboratory has been designed to study, with high angular accuracy, point sources of gamma rays of energy above 10^{14} eV. The experimental detector consists of an air shower array to observe gamma-ray showers and a shielded, large-area track detector to study the muon content of the showers. In this paper we present preliminary data from the array and describe its performance. 9 refs., 3 figs.

46603 (PNL-SA—13220) **Semi-empirical model of neutron and charged particle interactions with CR-39.** Parkhurst, M.A.; Hadlock, D.E.; Faust, L.G. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1985. Contract AC06-76RL01830. 7p. (CONF-8609110—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011121.

From International conference on solid state nuclear track detectors; Rome, Italy (23 Sep 1986).

The theory behind track detector response to neutrons is important to the calculation of dose equivalent, and the factors involved in track formation are diverse. We have envisioned a process by which individual parameters important to track interpretation would be identified, quantified, and categorized for use in model development and Monte Carlo calculations to establish dose equivalent algorithms. This paper focuses on just a few of the interactions under investigation in pursuit of empirical model development.

46604 (SLAC-PUB—3968) **SLAC pulsed x-ray facility.** Ipe, N.E.; McCall, R.C.; Baker, E.D. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 8p. (CONF-8606139—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012045.

From Health Physics Society meeting; Pittsburgh, PA, USA (30 Jun 1986).

The Stanford Linear Accelerator Center (SLAC) operates a high energy (up to 33 GeV) linear accelerator delivering pulses up to a few microseconds wide. The pulsed nature of the electron beam creates problems in the detection and measurement of radiation both from the accelerator beam and the klystrons that provide the rf power for the accelerator. Hence, a pulsed x-ray facility has been built at SLAC mainly for the purpose of testing the response of different radiation detection instruments to pulsed radiation fields. The x-ray tube consists of an electron gun with a control grid. This provides a stream of pulsed electrons that can be accelerated towards a confined target-window. The window is made up of aluminium 0.051 cm (20 mils) thick, plated on the vacuum side with a layer of gold 0.0006 cm (1/4 mil) thick. The frequency of electron pulses can be varied by an internal pulser from 60 to 360 pulses per second with pulse widths of 360 ns to 5 μs. The pulse

amplitude can be varied over a wide range of currents. An external pulser can be used to obtain other frequencies or special pulse shapes. The voltage across the gun can be varied from 0 to 100 kV. The major part of the x-ray tube is enclosed in a large walk-in-cabinet made of 1.9 cm (3/4 in) plywood and lined with 0.32 cm (1/8 in) lead to make a very versatile facility. 3 refs., 5 figs.

46605 **(SLAC-PUB—3980) Beamstrahlung monitor for SLC final focus using gamma ray energies.** Bonvicini, G.; Field, C.; Minten, A. (Michigan Univ., Ann Arbor (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). May 1986. Contract AC03-76SF00515. 2p. (CONF-860629—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012876.

From Linear accelerator conference; Stanford, CA, USA (2 Jun 1986).

Features of the beamstrahlung flux from the SLC interaction point are discussed, and intensity estimates given. A Cherenkov detector intended to monitor the flux is described.

46606 **(SLAC-PUB—4020) Front-end data processing the SLD data acquisition system.** Nielsen, B.S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1986. Contract AC03-76SF00515. 10p. (CONF-8605164—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013434.

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

The data acquisition system for the SLD detector will make extensive use of parallel at the front-end level. Fastbus acquisition modules are being built with powerful processing capabilities for calibration, data reduction and further pre-processing of the large amount of analog data handled by each module. This paper describes the read-out electronics chain and data pre-processing system adapted for most of the detector channels, exemplified by the central drift chamber waveform digitization and processing system.

46607 **Parallel-plate time projection chamber operation in a magnetic field.** Gruhn, C.; Natkaniec, Z.; Peisert, A.; Sauli, F. (Lawrence Berkeley Lab., CA, USA; European Organization for Nuclear Research, Geneva, Switzerland). *Nuclear Instruments and Methods in Physics Research;* **247**: No. 3, 460-466(1 Jul 1986).

A small time projection chamber with a parallel-plate avalanche chamber as an end-cap detector was tested in a magnetic field of up to 10 kG. An increase of sparking rate at a given gain with increasing magnetic field was observed.

46608 **Batteryless magneto-driven portable radiac.** Waechter, D.A.; Bjarke, G.O.; Trujillo, F.; Wolf, M.A.; Umbarger, C.J. (to Dept. of Energy, Washington, DC). US Patent 4,596,933. 24 Jun 1986. Filed date 19 Oct 1984. vp.

A portable radiation detector is described which consists of: a. hand powered alternator means for producing an alternating voltage by hand manipulation; b. rectifier means connected to the hand powered alternator means for producing an unregulated dc voltage from the alternating voltage; c. a capacitor connected to the rectifier means for storing the unregulated dc voltage; d. regulator means connected to the capacitor for producing a regulated low voltage from the stored unregulated dc voltage; e. high voltage means fed by the low voltage means for producing a high voltage output; f. radiation detecting means powered by the high voltage output for detecting radiation pulses; g. pulse detector means fed by the radiation detecting means for producing an electrical pulse for each radiation pulse detected by the radiation detecting means; h. event counting means fed by the pulse detector means for integrating the electrical pulses produced by the pulse detector means over a period of time and for producing an output signal representative thereof; i. LCD driving means coupled to the event counting means for translating the output signal thereof into a signal of suitable LCD display driving levels; and j. LCD display means coupled to the LCD driving means for visually displaying the signal of suitable LCD display driving levels.

46609 **State-of-the-art digital radiation survey meter.** Mahathy, J.M.; DeArmond, J.G. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN). pp 41-46 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

The prototype design for a new radiation survey meter includes a microprocessor, battery-backed data RAM, and the necessary hardware and software for data transfer. The human interface and other design features are discussed in the text. The unit should provide improved efficiency and data integrity. The data will be transferred to a personal computer which will do the necessary analysis. Some of the data will subsequently be transferred from the personal computer to a larger minicomputer where additional analyses and reports will be performed. One of these will be automated scheduling of area surveys.

46610 **Improved readout system for multi-crystal gamma cameras.** Derenzo, S.E. (to Dept. of Energy). US Patent Application 6-768,080. 21 Aug 1985. 16p. Contract AC03-76SF00098. DE86013746 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013746.

A radioisotope camera having an array of scintillation crystals arranged in N rows and M columns and adapted to be struck by gamma-rays from a subject, a separate solid state photodetector optically coupled to each crystal, and N + M amplifiers connected to the photodetectors to distinguish the particular row and column of an activated photodetector. One of the anode or cathode leads of each photodetector is coupled to the row amplifier associated with the row containing that photodetector while the other of the two leads is coupled to the column amplifier associated with the column containing that photodetector.

46611 **Apparatus for reading two-dimensional electrophoretograms containing β-ray-emitting labeled compounds.** Anderson, H.L.; Kinnison, W.W.; Lillberg, J.W. (to Dept. of Energy). US Patent Application 6-728,965. 30 Apr 1985. 21p. Contract W-7405-ENG-36. DE86013865 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013865.

An apparatus and method for electronically reading planar two-dimensional β-ray emitter-labeled gel electrophoretograms. A single, flat rectangular multiwire proportional chamber is placed in close proximity to the gel and the assembly placed in an intense uniform magnetic field disposed in a perpendicular manner to the rectangular face of the proportional chamber. Beta rays emitted in the direction of the proportional chamber are caused to execute helical motions which substantially preserve knowledge the coordinates of their origin in the gel. Perpendicularly oriented, parallel wire, parallel plane cathodes electronically sense the location of the β-rays from ionization generated thereby in a detection gas coupled with an electron avalanche effect resulting from the action of a parallel wire anode located therebetween. A scintillator permits the present apparatus to be rendered insensitive when signals are generated from cosmic rays incident on the proportional chamber. Resolution for concentrations of radioactive compounds in the gel exceeds 700-μm. The apparatus and method of the present invention represent a significant improvement over conventional autoradiographic techniques in dynamic range, linearity and sensitivity of data collection. A concentration and position map for gel electrophoretograms having significant concentrations of labeled compounds and/or highly radioactive labeling nuclides can generally be obtained in less than one hour.

46612 **Radiation detector spectrum simulator.** Wolf, M.A.; Crowell, J.M. (to Dept. of Energy). US Patent Application 6-721,352. 9 Apr 1985. 9p. Contract W-7405-ENG-36. DE86013802 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013802.

A small battery operated nuclear spectrum simulator having a noise source generates pulses with a Gaussian distribution of amplitudes. A switched dc bias circuit cooperating therewith to generate several nominal amplitudes of such pulses and a spectral distribution of pulses that closely simulates the spectrum produced by a radiation source such as Americium 241.

46613 **Fast counting electronics for neutron coincidence counting.** Swansen, J.E. (to Dept of Energy). US Patent Application 6-708,477. 5 Mar 1985. 15p. Contract W-7405-ENG-36. DE86013782 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013782.

An amplifier-discriminator is tailored to output a very short pulse upon an above-threshold input from a detector which may be a ^{3}He detector. The short pulse output is stretched and energizes a light emitting diode (LED) to provide a visual output of operation and pulse detection. The short pulse is further fed to a digital section for processing and possible ORing with other like generated pulses. Finally, the output (or ORed output) is fed to a derandomizing buffer which converts the rapidly and randomly occurring pulses into synchronized and periodically spaced-apart pulses for the accurate counting thereof. Provision is also made for the internal and external disabling of each individual channel of amplifier-discriminators in an ORed plurality of same.

46614 **New neutron small-angle diffraction instrument at the Brookhaven High Flux Beam Reactor.** Schneider, D.K.; Schoenborn, B.P. (Brookhaven National Lab., Upton, NY). pp 119-141 of Neutrons in biology. Schoenborn, B.P. (ed.). New York, NY; Plenum Publishing Corporation (1984).

This instrument utilizes cold neutrons emerging from a series of straight neutron guides. A multilayered monochromator is used in combination with a short collimator to obtain a monochromatized beam with a wavelength between 4 and 10 A and a wavelength spread of about 10%. The flux at 5 A exceeds 10^6 ns^{-1} cm^{-2} in a typical beam of 6-mm diameter at the sample. The spectrometer itself incorporates provisions for computer-controlled positioning of samples and a two-dimensional detector. At a sample-detector distance between 50 and 200 cm the detector can be centered at scattering angles of up to 45°. The beam-defining components, the monochromator, the collimator, and various slits, are easily accessible and exchangeable for alternative devices. These features make the instrument modular and give it flexibility approaching that of standard x-ray equipment. The facility in its first year on line was used most of the time for solution-scattering experiments. These included experiments to investigate the structure of plasma lipoproteins, to further the triangulation of the small ribosomal subunit, and to characterize micellar microemulsions. The spectrometer is equally suited to measuring diffraction at higher angles on oriented specimens. In this paper, the components of the instrument are described, its performance is discussed, and characteristic parameters are compiled. 25 references, 14 figures, 3 tables.

46615 **Superheated drop nucleation for neutron detection.** Apfel, R.E.; Chu, B.T.; Mengel, J. (Yale Univ., New Haven, CT). *Applied Scientific Research (The Hague);* **38**: 117-122(1982).

Moderately superheated drops of liquid in a gel will vaporize when exposed to neutrons. The basic characteristics of such detectors are described, with emphasis on a model for the dynamics of the process of vapor bubble nucleation. 5 references, 1 figure.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 46168, 46403

46616 (INIS-mf—10173, pp 53) **Laboratory study of radiation damage to drift chambers.** Kotthaus, R.; Ishihara, N.; Kohriki, T.; Kubo, K.; Nakamura, S.; Odaka, S.; Suekane, F.; Watase, Y. (National Lab. for High Energy Physics, Oho, Ibaraki, Japan; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany, F.R.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Abstr.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 45607, 45624, 45690, 45714, 45762, 46044, 46080, 46081, 46082, 46083, 46084, 46085, 46086, 46087, 46088, 46089, 46091, 46098, 46102, 46202, 46329, 46342, 46367, 46385, 46467, 46560, 47059

46617 **(BNL—38364) EXAFS and reflectivity studies of surfaces and interfaces using glancing angle x-rays.** Heald, S.M.; Chen, H.; Tranquada, J.M. (Brookhaven National Lab., Upton, NY (USA). Applied Science Dept.). 1986. Contract AS05-80ER10742;AC02-76CH00016. 7p. (CONF-860880—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014171.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

X-rays at glancing angles have a short controllable penetration depth which can be used to advantage in studying surfaces and interfaces. Data are presented for Cu-Al and Ag-Au bilayers which demonstrate the utility of x-ray reflectivity and extended x-ray absorption fine structure (EXAFS) measurements. X-ray reflectivity measurements are sensitive to layer thickness and interface roughness, while the EXAFS probes the atomic scale environment of the interface atoms. As the samples are annealed clear changes are observed in both techniques indicative of the growth of interfacial $CuAl_2$ for the Cu-Al samples and interdiffusion for Ag-Au. Interface sensitivity is verified for the Cu-Al samples by the observations that the EXAFS signal changes from Cu-like to $CuAl_2$-like with the growth of ~100 A of $CuAl_2$. Quantitative fits to the x-ray reflectivity data are used to obtain interface roughness, and indicate that the growing $CuAl_2$ layer has a roughness comparable to its thickness. This is consistent with compound growth proceeding predominantly along grain boundaries.

46618 **(K/TS—11-771) Thermal phosphor research survey.** Dowell, L.J.; Gillies, G.T.; Allison, S.W.; Cates, M.R. (Virginia Univ., Charlottesville (USA). Dept. of Nuclear Engineering and Engineering Physics; Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1986. Contract AC05-84OT21400. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014373.

This document is a survey of the technical literature concerning aspects of phosphor materials science and spectroscopy which are of interest. These materials are the basis of temperature measurement methods currently under development. The numerical identification to the left of each citation is that given in the Physics Abstracts. 750 refs.

46619 **(LBL—20466) Reflection grating spectrometer for the x-ray multi-mirror (XMM) space observatory: design and calculated performance.** Hettrick, M.C.; Kahn, S.M. (Lawrence Berkeley Lab., CA (USA)). Oct 1985. Contract AC03-76SF00098. 14p. (CONF-8511123—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013485.

From 2. international technical symposium on optical and electro-optical applied science and engineering; Cannes, France (25 Nov 1985).

A spectrometer design candidate is presented for the X-ray Multi-Mirror (XMM) observatory, being planned by the European Space Agency (ESA) as a long-lived large-area of telescopes. The science requirement of moderate resolution ($E/\Delta E$ ~100) spectroscopy in a two octave region (0.5 to 2 keV) with extremely high throughput (effective area > 500 cm^2) results in the use of grazing incidence reflection gratings. Due to the low image quality of the telescopes (~ 1 minute of arc), the grating dispersion must be maximized by use of the classical grating mount in which the spectrum is dispersed within the plane of incident radiation. Due to the small field of view by the x-ray telescopes, the gratings must be situated in the converging beam at the exit of the telescope. A spectrometer module consists of a thin-foil conical mirror telescope, a stack of plane varied-space reflection gratings and an imaging proportional counter. This system is analyzed on the basis of dispersion, geometric aberrations and efficiency. At a spectral resolution of 0.15 A, a twenty module XMM would attain an average effective area of ~900 cm^2, reaching twice this value at the peak wavelength (15 A). Similar throughput is obtained in second order centered at 7.5

A, the two spectral orders separated by the non-dispersive energy resolution of the proportional counter. Continuous spectra are obtained in the 6-25 A band (0.5 to 2 keV), and can be extended to 45 A if desired by tuning of the grating. The instrument sensitivity is sufficient to allow the first spectral detection of soft x-ray features in external galaxies, with access to an estimated population of several hundred active galactic nuclei. Such observations will expand vastly the roles feasible for spectroscopy in x-ray astrophysics, marking the beginning of a new era in space astronomy.

46620 **(SAND—86-1544C) Streak measurements of the RADLAC-11 relativistic electron beam.** Crist, C.E.; Leifeste, G.T.; Ekdahl, C.A. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 5p. (CONF-8606153—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012945.

From DARPA conference; Albuquerque, NM, USA (23 Jun 1986).

A computer-controlled streak camera system has been configured for use in the lead pulse stability experiments on the RADLAC-II accelerator. The system consists of a Digital Equipment Corporation (DEC) LS-11/73 computer, a Hamamatsu C1000 SIT camera, a Hamamatsu C1440-04 temporal analyzer, and a Hamamatsu C1370 streak camera. The instrument provides 100 nsec streak records with a spacial resolution of better than 0.5 cm. A description of the system will be given along with typical output using data from the 1985 summer propagation experiment. 3 figs.

46621 **Rectangular waveguide calorimeter for single intense microwave pulses.** Earley, L.M.; Ballard, W.P.; Roose, L.D. (Microwave Physics Division, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **57**: No. 9, 2359-2361(Sep 1986).

A new calorimeter for single intense microwave pulses has been designed and tested. The device was constructed in WR284 rectangular waveguide and was operated at frequencies from 2.5 to 4.3 GHz with a tunable instantaneous bandwidth of approximately 500 MHz. The calorimeter used a single thermistor to measure the energy deposited on a carbon absorber having a microwave power absorbance of 90%. The calorimeter was tested at power levels from 100 to 1000 MW for pulse lengths of 12—6 ns, respectively. The sensitivity of the device was 200—300 mV/J.

46622 **Inexpensive and high-precision digital power supply and counting interface for UPS, XPS, and Auger spectrometers.** Lichtenberger, D.L.; Kellogg, G.E.; Kristofzski, J.G.; Page, D.; Turner, S.; Klinger, G.; Lorenzen, J. (Laboratory for Electron Spectroscopy and Surface Analysis, Department of Chemistry, University of Arizona, Tucson, Arizona 85721). *Review of Scientific Instruments;* **57**: No. 9, 2366-2366(Sep 1986).

A digital data-acquisition system has been built to interface two photoelectron spectrometers to a DEC LSI-11/23 processor.

46623 **Energy dissipation processes in scanning tunneling microscopy.** Flores, F.; Echenique, P.M.; Ritchie, R.H. (Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2899-2902(15 Aug 1986).

Energy dissipation associated with assisted tunneling processes in scanning tunneling microscopy is analyzed and compared with the normal tunnel current. We find that, for high voltages, greater than one volt, the tunneling processes associated with electron-hole pair excitation control the increase in temperature at the microscope's interface.

46624 **Thermal sensor with an improved coating.** LaDelfe, P.C.; Stotlar, S.C. (to Dept. of Energy, Washington, DC). US Patent 4,595,832. 17 Jun 1986. Filed date 30 Mar 1984. vp.

An apparatus is described for detecting electromagnetic radiation in the form of high speed laser pulses of at least 50 MHz, the radiation having wavelengths from about 0.4 μm to about 5.6 μm. The apparatus consists of: a. a pyroelectric thermal sensing means for generating an electrical signal in response to impinging radiation, the thermal sensing means having a top and a bottom surface, the impinging radiation being directed toward the top surface; b. a first electrode for receiving and conducting electrical charges generated on the top surface of the thermal sensing means, the first electrode being disposed on the top surface; c. A second electrode for receiving and conducting electrical charges generated on the bottom surface of the thermal sensing means, the second electrode being disposed on the bottom surface; and d. an optical coating for increasing the absorption of the impinging radiation, the optical coating including a first metallic layer disposed on the first electrode, and a first anti-reflector disposed on the first metallic layer, the optical coating having a thickness of less the 2000 A and a mass of less than 100 $\mu g/cm^2$, the optical coating placing a sufficiently small thermal load on the sensing means that the sensing means has a response time of less than one nanosecond.

46625 **Pattern recognition in piezoelectric sensor research at the Center for Process Analytical Chemistry.** Beebe, K.R.; Illman, D.L.; Carey, W.P.; Kowalski, B.R.; Hirschfeld, T. (Univ. of Washington, Seattle). pp 309-314 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

An introduction to Process Analytical Chemistry is given, and an application of chemometrics to a specific problem is discussed. Principle component analysis is used to select an array of seven piezoelectric crystal sensors from an original set of 27 possibilities. The goal of the procedure is to devise a rational selection technique that can be employed to select the most information-rich array of sensors.

46626 **Chemoresistive gas sensor.** Hirschfeld, T.B. (to Dept. of Energy). US Patent Application 6-781,543. 30 Sep 1985. 14p. Contract W-7405-ENG-48. DE86013766 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013766.

A chemoresistive gas sensor is provided which has improved sensitivity. A layer of organic semiconductor is disposed between two electrodes which, in turn, are connected to a voltage source. High conductivity material is dispersed within the layer of organic semiconductor in the form of very small particles, or islands. The average interisland spacing is selected so that the predominant mode of current flow is by way of electron tunneling. Adsorption of gaseous contaminant onto the layer of organic semiconductor modulates the tunneling current in a quantitative manner.

46627 **Multichannel optical sensing device.** Selkowitz, S.E. (to Dept. of Energy). US Patent Application 6-766,168. 16 Aug 1985. 26p. Contract AC03-76SF00098. DE86013675 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013675.

A multichannel optical sensing device is disclosed, for measuring the outdoor sky luminance or illuminance or the luminance or illuminance distribution in a room, comprising a plurality of light receptors, an optical shutter matrix including a plurality of liquid crystal optical shutter elements operable by electrical control signals between light transmitting and light stopping conditions, fiber optical elements connected between the receptors and the shutter elements, a microprocessor based programmable control unit for selectively supplying control signals to the optical shutter elements in a programmable sequence, a photodetector including an optical integrating spherical chamber having an input port for receiving the light from the shutter matrix and at least one detector element in the spherical chamber for producing output signals corresponding to the light, and output units for utilizing the output signals including a storage unit having a control connection to the microprocessor based programmable control unit for storing the output signals under the sequence control of the programmable control unit.

46628 **Gage for measuring displacements in rock samples.** Holcomb, D.J.; McNamee, M.J. (to Dept. of Energy). US Patent Application 6-756,127. 18 Jul 1985. 26p. Contract AC04-76DP00789. DE86013694 NTIS, PC A03/MF A01; GPO Dep. File Number DE86013694.

A gage for measuring diametral displacement within a rock sample for use in a rock mechanics laboratory and in the field,

comprises a support ring housing a linear variable differential transformer (LVDT), a mounting screw, and a leaf spring. The mounting screw is adjustable and defines a first point of contact with the rock sample. The leaf spring has opposite ends fixed to the inner periphery of the mounting ring. An intermediate portion of the leaf spring projecting radially inward from the ring is formed with a dimple defining a second point of contact with the sample. The first and second points of contact are diametrically opposed to each other. The LVDT is mounted in the ring with its axis parallel to the line of measurement and its core rod received in the dimple of the leaf spring. Any change in the length of the line between the first and second support points is directly communicated to the LVDT. The leaf spring is rigid to completely support lateral forces so that the LVDT is free of all load for improved precision.

46629 **Tube wall thickness measurement apparatus.** Lagasse, P.R. (to Dept. of Energy). US Patent Application 6-747,204. 21 Jun 1985. 14p. Contract W-7405-ENG-36. DE86013742 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013742.

An apparatus for measuring the thickness of a tube's wall for the tube's entire length and radius by determining the deviation of the tube wall thickness from the known thickness of a selected standard item. The apparatus comprises a base and a first support member having first and second ends. The first end is connected to the base and the second end is connected to a spherical element. A second support member is connected to the base and spaced apart from the first support member. A positioning element is connected to and movable relative to the second support member. An indicator is connected to the positioning element and is movable to a location proximate the spherical element. The indicator includes a contact ball for first contacting the selected standard item and holding it against the spherical element. The contact ball then contacts the tube when the tube is disposed about the spherical element. The indicator includes a dial having a rotatable needle for indicating the deviation of the tube wall thickness from the thickness of the selected standard item.

46630 **Remotely readable fiber optic compass.** Migliori, A.; Swift, G.W.; Garrett, S.L. (to Dept. of Energy). US Patent Application 6-728,976. 30 Apr 1985. 21p. Contract W-7405-ENG-36. DE86013708 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013708.

A remotely readable fiber optic compass. A sheet polarizer is affixed to a magnet rotatably mounted in a compass body, such that the polarizer rotates with the magnet. The optical axis of the sheet polarizer is preferably aligned with the north-south axis of the magnet. A single excitation light beam is divided into four identical beams, two of which are passed through the sheet polarizer and through two fixed polarizing sheets which have their optical axes at right angles to one another. The angle of the compass magnet with respect to a fixed axis of the compass body can be determined by measuring the ratio of the intensities of the two light beams. The remaining ambiguity as to which of the four possible quadrants the magnet is pointing to is resolved by the second pair of light beams, which are passed through the sheet polarizer at positions which are transected by two semicircular opaque strips formed on the sheet polarizer. The incoming excitation beam and the four return beams are communicated by means of optical fibers, giving a remotely readable compass which has no electrical parts.

46631 **Process for measuring degradation of sulfur hexafluoride in high voltage systems.** Sauers, I. (to Dept. of Energy). US Patent Application 6-726,564. 23 Apr 1985. 18p. Contract AC05-84OR21400. DE86013808 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013808.

This invention is a method of detecting the presence of toxic and corrosive by-products in high voltage systems produced by electrically induced degradation of SF_6 insulating gas in the presence of certain impurities. It is an improvement over previous methods because it is extremely sensitive, detecting by-products present in parts per billion concentrations, and because the device employed is of a simple design and takes advantage of the by-products natural affinity for fluoride ions. The method employs an ion-molecule reaction cell in which negative ions of the by-products are produced by fluorine attachment. These ions are admitted to a negative ion mass spectrometer and identified by their spectra. This spectrometry technique is an improvement over conventional techniques because the negative ion peaks are strong and not obscured by a major ion spectra of the SF_6 component as is the case in positive ion mass spectrometry.

46632 **Atmospheric pressure helium afterglow discharge detector for gas chromatography.** Rice, G.; D'Silva, A.P.; Fassel, V.A. (to Dept. of Energy). US Patent Application 6-720,328. 5 Apr 1985. 15p. Contract W-7405-ENG-82. DE86013799 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013799.

An apparatus for providing a simple, low-frequency, electrodeless discharge system for atmospheric pressure afterglow generation. A single quartz tube through which a gas mixture is passed is extended beyond a concentric electrode positioned thereabout. A grounding rod is placed directly above the tube outlet to permit optical viewing of the discharge between the electrodes.

46633 **X-ray holographic microscopy experiments at the Brookhaven synchrotron light source.** Howells, M.R.; Iarocci, M.; Kenney, J.; Kirz, J.; Rarback, H. (Brookhaven National Lab., Upton, NY). *Proceedings of the Society of Photo-Optical Instrumentation Engineers;* 447: 193-203(1984).

Soft x-ray holographic microscopy is discussed from an experimental point of view. Three series of measurements have been carried out using the Brookhaven 750 MeV storage ring as an x-ray source. Young slits fringes, Gabor (in line) holograms and various data measurements are discussed in terms of the technique for recording them and the experimental limitations in effect. Some discussion is also given of the issues involved in reconstruction using visible light. 19 references, 12 figures, 1 table.

46634 **Inductively coupled plasma mass spectrometry (ICP-MS): Effects of experimental parameters on ion energy distributions.** Olivares, J.A.; Houk, R.S. (Dept. of Chemistry, Iowa State Univ., Ames, IA 50011). pp 412-413 of Proceedings of the 32nd annual conference on mass spectrometry and allied topics. Philadelphia, PA; ASTM (1984). (CONF-8405185—).

From 32. annual conference on mass spectrometry and allied topics; San Antonio, TX, USA (27 May 1984).

A study of the ion source in any mass spectrometer should include a thorough knowledge of the kinetic energy distributions of ions from the source. Specifically, the effect of source parameters on the energy distributions of sampled ions will give a better understanding of the effects of these parameters on signal and spectrometer resolution. These results indicate that the introduction of water into the central channel of the ICP has little if any effect on the ion energy distribution from this source. On the other hand, the argon gas which punches the central channel through the ICP has a dramatic effect on the ion energy distribution. Parameters which directly affect the physical properties of this central channel indirectly affect the measured ion energy distributions leading to the results described above.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 45738, 46239

46635 **(UCRL—94857) Experiments with small helical flux compression generators.** Abe, D.K.; Chase, J.B. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 7p. (CONF-860703—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014439.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

Lawrence Livermore National Laboratory (LLNL) uses small high explosives driven flux compression generators as power sources for exploding bridgewire loads. To better characterize these generators, a series of experiments using constant impedance loads

was performed. These experiments included generators driving purely resistive, purely inductive and short circuited loads. Voltage, current and di/dt waveforms were measured and flash radiographs were taken. 5 refs., 8 figs., 1 tab.

4502 Nuclear

REFER ALSO TO CITATION(S) 46650

46636 (AD-A—167805/1/XAB) DOD (Department of Defense) nuclear mishaps. Special report. Reese, H.L. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Mar 1986. 18p. NTIS, PC A02/MF A01.

This report summarizes Department of Defense nuclear mishaps from 1950 to 1980. The information presented is material available in the public domain at the time of publication.

46637 (AD-A—167959/6/XAB) Radiation doses from flying through nuclear-debris clouds. Final report, 2-10 January 1985. Vanden Bosch, P.M. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Apr 1986. 20p. (USAF-SAM-TR—85-86). NTIS, PC A02/MF A01.

Taboada et al. have recently developed a computer model to predict gamma radiation doses to aircrews flying through nuclear-debris clouds. Although the model has the advantages of taking a large number of parameters into account and using the benchmark DELFIC code to model cloud dynamics, it takes up to 20 min for a single run on a mainframe computer. Results from a number of runs have been generalized into empirical formulae. From these results it is possible to estimate worst case gamma radiation doses for complex scenarios using a hand calculator.

46638 (DOE/DP/50039—T1) US arms control obligations under the Non-Proliferation Treaty. (Eagle Research Group, Inc., Arlington, VA (USA)). 27 Jun 1986. Contract AC01-84DP50039. 27p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86013943.

Article VI of the 1968 Non-Proliferation Treaty (NPT) obligates the nuclear weapon states parties to the Treaty "to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race, ... to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The preamble to the NPT recalls the 1963 Limited Test Ban Treaty "determination ... to achieve the discontinuance of ... explosions." These provisions are interpreted by a majority of the non-nuclear weapon states parties to the Treaty as an obligation of the nuclear weapon states parties to the Treaty to pursue a comprehensive test ban (CTB). However, a review of the history of the NPT negotiations and US ratification proceedings makes clear that the NPT imposes no legal obligation on the US to pursue a CTB. The US did not make a one-to-one correspondence between Article VI and any specific arms control measure; to the contrary, the US argued successfully that such a connection (to any specific measure) would be pernicious to the attempt to achieve agreement on the NPT. This interpretation, which was sustained through the negotiations and the ratification proceedings, still reflects the limits of the legal obligations the US has accepted. But, in the absence of progress on other arms control measures, which would relieve the pressure for a CTB, the majority interpretation creates political difficulties for the US and could threaten the NPT regime in the future. These problems highlight the need for the US to better defend its compliance with Article VI and to develop a long-term strategy that will permit necessary testing while assuring the survival of the NPT regime in effective form.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

46639 (EUR—10353-EN-FR) Measurement of precipitation by radar. Cost project 72. Proceedings. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 250p. (CONF-8509315—). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

From Seminar on an integrated weather radar network for Western Europe; Erice, Italy (30 Sep 1985).

Physical sciences.

Two main topics have been examined, namely the possibilities for standardization of radar equipment for Western Europe, and a study of the feasibility and utility of international exchanges of radar data. Both these aspects are addressed in these proceedings. The proceedings are presented in two sections. Section 1 covers the whole range of work studied by COST-72, and Section 2 deals with individual country status reports.

46640 Freeze-up and break-up of Lakes as an index of temperature changes during the transition seasons: A case study for Finland. Palecki, M.A.; Barry, R.G. (Cooperative Institute for Research in Environmental Sciences and Department of Geography, University of Colorado, Boulder, CO 80309). *Journal of Applied Meteorology;* **25**: No. 7, 893-902(Jul 1986).

The statistical relationships between lake freeze-up/lake ice break-up dates and air temperature means over various time periods are analyzed for 63 lakes in Finland. Mean temperatures for the individual months before the lake event dates are strongly correlated with these dates; significant correlations hold for periods up to five months in length before freeze-up. Regression coefficients depend on location, but are consistent within regions. Latitude and distance from the coast are the most important sources of variation in the regression coefficients. The regression coefficients are used to translate changes in lake freeze-up/break-up dates into estimated changes in air temperature. In southern Finland a five day change in freeze-up day would represent a 1.1° C change in November temperature of the same sign. A time series of November temperatures estimated from lake freeze-up dates is derived and compared with observations at Helsinki. The spatial pattern of temperature change over time is also examined using the freeze-up dates. Freeze-up/break-up dates provide a useful proxy for air temperature estimates in data-sparse regions of middle—high latitudes and could permit rapid satellite monitoring of climate perturbations.

46641 Decreasing diurnal temperature range in the United States and Canada from 1941 through 1980. Karl, T.R.; Kukla, G.; Gavin, J. (NOAA/National Climatic Data Center, Asheville, NC). *Journal of Climate and Applied Meteorology;* **23**: No. 11, 1489-1504(Nov 1984). Contract AC02-83ER60162.

An appreciable number of nonurban stations in the US and Canada have decreasing trends in the monthly mean diurnal temperature range between 1941-80, at the 90% confidence level. A maximum in the decrease is reached during late summer and early autumn and a minimum in December. Monte Carlo tests indicate that during 5 months the field significance of the decreasing range is above the 99% level and in 12 months above the 95% level. The decrease in diurnal temperature ranges is related to the trend toward increasing temperature in the western part of North America and decreasing temperature in the east. The physical mechanism responsible for the observed decrease in diurnal range is not known. Possible explanations include greenhouse effects such as changes in cloudiness, aerosol loading, atmospheric water vapor content, or carbon dioxide. Change in circulation is also possible, but difficult to isolate because of low spatial coherence. The data further show that the trends in the maximum and minimum temperatures may differ considerable from trends in the mean.

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 45629, 45698, 46049, 46054, 46063, 46251

46642 (DOE/ER/60397—1) Detection of CO_2-induced climate change. Progress report, 1 December 1985-15 July 1986. Wigley, T.M.L.; Jones, P.D. (East Anglia Univ. (UK). Climatic Research Unit). 15 Jul 1986. Contract FG02-86ER60397. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014035.

The objective is to assemble and analyze present and past instrumental climate data as a basis for detecting CO_2-induced climatic change and for validation of climate models. This report describes progress in the following areas: (1) southern hemisphere temperature data; (2) updating of gridded temperature data; (3) satellite data; (4) marine temperature data sets; (5) analysis of gridded mean sea level pressure data; (6) regional validation of climate models; and (7) detection studies. (ACR)

46643 (EUR—10295-EN) Certification of polycyclic aromatic compounds. Pt. 6. CRM Nos. 152, 265, 266, 267, 268, 269, 270, 271, 272. Jacob, J.; Belliardo, J.J.; Wagstaffe, P.J. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1985. 53p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information.

The purity of samples of seven polycyclic aromatic hydrocarbons and two nitrogen-containing heterocyclics has been determined in an interlaboratory exercise, involving eleven laboratories of the EC member countries. The purity measurements were carried out using independent analytical methods (gas liquid chromatography, high performance liquid chromatography and mass spectrometry). This report describes the certification procedure and experimental details of the interlaboratory analyses of standard materials for environmental pollutants.

46644 (N—86-25911) Present state of knowledge of the upper atmosphere: an assessment report; processes that control ozone and other climatically important trace gases. Watson, R.T.; Geller, M.A.; Stolarski, R.S.; Hampson, R.F. (National Aeronautics and Space Administration, Washington, DC (USA)). May 1986. 149p. (NASA-RP—1162). NTIS, PC A07/MF A01.

The state of knowledge of the upper atmosphere was assessed as of January 1986. The physical, chemical, and radiative processes which control the spatial and temporal distribution of ozone in the atmosphere; the predicted magnitude of ozone perturbations and climate changes for a variety of trace gas scenarios; and the ozone and temperature data used to detect the presence or absence of a long term trend were discussed. This assessment report was written by a small group of NASA scientists, was peer reviewed, and is based primarily on the comprehensive international assessment document entitled Atmospheric Ozone 1985: Assessment of Our Understanding of the Processes Controlling Its Present Distribution and Change, to be published as the World Meteorological Organization Global Ozone Research and Monitoring Project Report No. 16.

46645 (PB—86-190246/XAB) Practical guide - trial burns for hazardous-waste incinerators. Final report, 1984-1985. Gorman, P.; Hathaway, R.; Wallace, D.; Trenholm, A. (Midwest Research Inst., Kansas City, MO (USA)). Apr 1986. 75p. NTIS, PC A04/MF A01.

The manual concentrates on those aspects of a trial burn that are the most important and those that are potentially troublesome. The manual contains practical explanations based on experience of Midwest Research Institute (MRI) and others in conducting trial burns and related tests for EPA. It includes the comments of several industrial plant owners and operators. It is directed mainly to incinerator operators, those who may conduct the actual sampling and analysis, and those who must interpret trial-burn results. It will also be useful for regulatory personnel and others that need to understand trial burns. Potential trouble spots that have been encountered are: (1) trial burns frequently take more time and effort than an operator anticipates; and (2) failure to meet the trial-burn requirements.

46646 (PB—86-208360/XAB) Global atmospheric background monitoring for selected environmental parameters: BAPMON data for 1981: Volume 2. Precipitation chemistry, continuous atmospheric carbon dioxide, and suspended particulate matter. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Jun 1985. 201p. (EPA/600/4—85/015). NTIS, PC A10/MF A01.

The report is the seventh in series reporting precipitation data from stations participating in the World Meterological Organization's network. The report consists of tables of raw data received from network sites around the world.

46647 Use of a toxic and hazardous aerosol research facility to evaluate fate and effects of army smoke screen materials. Van Voris, P.; Ligotke, M.W.; McFadden, K.M.; Cataldo, D.A.; Garland, T.R. (Pacific Northwest Lab., Richland, WA). pp 3-8 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—). Contract AC06-76RL01830.

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

Aerosols are generated and injected into a new specialized wind tunnel that can reproduce a range of environmental conditions. The wind tunnel is part of the Toxic and Hazardous Aerosol Exposure Facility (T/HAEF) located at Pacific Northwest Laboratory on the Department of Energy's Hanford Site in Richland, Washington. The T/HAEF is designed for total containment (P-3 rated) and houses a sealed, negative pressure, recirculating wind tunnel, controlled environment chambers, microcomputer and an analytical support laboratory. The facility offers a unique ability to conduct aerosol research in a dynamic environment simulating natural field conditions. Wind speeds from 0.2 to 30.0 m/s (65 mph), temperatures between 0 and 45°C, and relative humidities from 20% to 95% with mist and rainfall simulation are controlled and programmable through the microcomputer system. The T/HAEF enables researchers to evaluate physical and chemical interactions along with biological and environmental fate and effects of both aerosols and gases. Research currently being performed in this facility and presented in this paper evaluates the environmental fate and effects of various smokes used by the US Army throughout the United States to screen both troop and track vehicle movements during training.

46648 Transformation processes and wet deposition on the urban scale. Patrinos, A.A.N.; Tanner, R.L.; Brown, R.M. (Brookhaven National Lab., Upton, NY). pp 224-227 of Fourth joint conference on applications of air pollution meteorology. Boston, MA; American Meteorology Society (1984). Contract AC02-76CH00016.

From 4. joint conference on applications of air pollution meteorology; Portland, OR, USA (15-19 Oct 1984).

This paper presents preliminary results from a study addressing the potential contribution of urban emissions to the total acid wet deposition load downwind of a large city and the spatial variability of this deposition on the surburban-rural scale. Among the candidate cities along the northeastern corridor, Philadelphia was chosen as a test site because it has substantial and well-documented emissions and because it is sufficiently inland to minimize complications from a purely coastal location. Emphasis was placed on frontal-type precipitation; according to one estimate (Raynor and Hayes, 1979) cyclonic storms account for the largest portion (> 60%) of wet deposition in the northeastern US. The Philadelphia field study involved the sampling of two precipitation events during fall 1983, and an intensive sampling period (March-April 1984) during which nine storms were sampled. Preliminary results from the fall expeditions were given in the paper by Patrinos and Brown (1984). This paper also concentrates on the 1983 results. 12 references, 5 figures.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45951, 45952, 45953, 45954, 45955, 46236, 46273, 46286, 46579, 46659, 46661, 46663

46649 (DOE/DP/00539—056) Off-site environmental monitoring report. Radiation monitoring around United States nuclear test areas, calendar year 1985. Grossman, R.F.; Black, S.C.; Dye, R.E.; Smith, D.D.; Thome, D.J.; Mullen, A.A. (comps.). (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Apr 1986. Contract AI08-76DP00539. 154p. (EPA—600/4-86/022). NTIS, PC A08/MF A01; GPO Dep. File Number DE86014406.

The EMSL-LV operates an Off-Site Radiological Safety Program around the NTS and other sites as requested by the Department of Energy (DOE) under an Interagency Agreement between DOE and EPA. This report, prepared in accordance with DOE guidelines (DOE85a), covers the program activities for calendar year 1985. It contains descriptions of pertinent features of the NTS and its environs, summaries of the EMSL-LV dosimetry and sampling methods, analytical procedures, quality assurance, and the analytical results from environmental measurements. Where applicable, dosimetry and sampling data are compared to appropriate guides for external and internal exposures of humans to ionizing radiation.

46650 (DOE/DP/00539—057) Off-site monitoring for the Mighty Oak nuclear test. Black, S.C.; Smith, A.E.; Costa, C.F. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Jul 1986. Contract AI08-76DP00539. 19p. (EPA—600/4-86-030). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014090.

After a nuclear explosives test, code name Mighty Oak, the tunnel leading to the test point became contaminated with radioactive debris. To re-enter and recover valuable equipment and data, the DOE purged the tunnel air using particulate and charcoal filters to minimize discharge of radioactivity to the atmosphere. During this purging, the EPA established special air samples supplementing their routine air monitoring networks. Analysis of the collected samples for radioactive noble gases and for gamma-emitting radionuclides indicated that only low levels of xenon-133 were released in amounts detectable in populated areas near the Nevada Test Site. The maximum dose to an individual was calculated to be 0.36 microrem, assuming that person remained in the open field at the measurement site during the whole period of the purging.

46651 (PPA-T—13) Environmental survey at the Tun Ismail Atomic Research Centre (PUSPATI), Bangi, Malaysia. Results for 1980-1981. Lau How Mooi. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Nov 1981. 80p. Nuclear Energy Unit, Bangi, 43000 Kajang, Malaysia.

This report contained the results of the preoperational environmental monitoring, which was started mid 1980. Due to some problems with some detectors, only results from January to June, 1981 were reported in this paper. Only gross gamma and gamma spectrometric measurements were reported here. The gross beta and alpha measurements were reported elsewhere. The ecological study and the river biology study which were done by the National University and the Agriculture University respectively were also reported elsewhere.

5006 Regulations

REFER ALSO TO CITATION(S) 45989, 46643

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

REFER ALSO TO CITATION(S) 46705

46652 (CONF-8605167—1) Nitrogen cycling models and their application to forest harvesting. Johnson, D.W.; Dale, V.H. (Oak Ridge National Lab., TN (USA). Environmental Sciences Div.). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013410.

From Workshop on forest crop nutrition: production, prices and pathways; Kingston, Ontario, Canada (20 May 1986).

The characterization of forest nitrogen- (N-) cycling processes by several N-cycling models (FORCYTE, NITCOMP, FORTNITE, and LINKAGES) is briefly reviewed and evaluated against current knowledge of N cycling in forests. Some important processes (e.g., translocation within trees, N dynamics in decaying leaf litter) appear to be well characterized, whereas others (e.g., N mineralization from soil organic matter, N fixation, N dynamics in decaying wood, nitrification, and nitrate leaching) are poorly characterized, primarily because of a lack of knowledge rather than an oversight by model developers. It is remarkable how well the forest models do work in the absence of data on some key processes. For those systems in which the poorly understood processes could cause major changes in N availability or productivity, the accuracy of model predictions should be examined. However, the development of N-cycling models represents a major step beyond the much simpler, classic conceptual models of forest nutrient cycling developed by early investigators. The new generation of computer models will surely improve as research reveals how key nutrient-cycling processes operate.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 46226, 46250, 46647

46653 (AD-A—167741/8/XAB) Installation restoration program: Phase I. Records search, Lawndale Annex, California. Final report, 1 July 1985-31 January 1986. Hendry, C.D.; Pandorf, W.; Doolittle, J.; McNeill, D.F.; Stewart, M.D. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). Apr 1986. 135p. NTIS, PC A07/MF A01.

Past and current employees were interviewed, records were reviewed, regulatory agencies were contacted, and a ground reconnaissance was conducted. Past waste-handling and disposal practices were evaluated, and two past waste-disposal sites were identified. The sites were evaluated using a decision-tree process. Both sites were found to have no potential for contaminant migration or endangerment of human health or environmental quality; therefore no Phase II actions are recommended. Both sites were referred to the base environmental program for investigation.

46654 (AD-A—167798/8/XAB) Installation restoration program. Phase II. Confirmation/quantification. Stage I report for Williams Air Force Base, Chandler, Arizona. Final report, September 1984-January 1986. (AeroVironment, Inc., Monrovia, CA (USA)). 24 Jan 1986. 318p. NTIS, PC A14/MF A01.

AeroVironment Inc. was tasked to conduct a Phase II Stage I investigation at Williams AFB, near Phoenix, AZ. The objective was to confirm and to quantify the presence and extent of contamination at the fire protection training area 2 (FPTA), liquid fuels storage area (LFSA), surface drainage system - southwest, landfill, pesticide burial area, and surface drainage system - northwest.

Drilling and soil sampling were conducted at the FPTA, FLSA, and landfill. Thirty-one holes were drilled in the three areas. Surface soil samples were collected along the two drainage channels. Also, a magnetometer survey was conducted at the pesticide burial area. A total of 272 samples were collected. Of the 272 samples collected, 204 were analyzed in the laboratory. Soil contamination was found at: 1) small burn pit at FPTA, 2) drainage outfall at FPTA, 3) old AVGAS distribution system at LFSA, and 4) southwest drainage system. Magnetic anomalies (buried drums) were identified at the pesticide burial area. Recommendations made for Williams include: 1) remove surface soils from the southwest drainage, 2) excavate and inspect the identified buried materials at the pesticide disposal area, 3) collect additional samples around contamination at the FPTA and LFSA.

46655 (OEFZS—4356) Determination of total sulphur in soil - a comparison of methods. Gerzabek, M.H.; Schaffer, K. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Landwirtschaft). Apr 1986. 7p. (In German). (LA—154/86). Special print from Bodenkultur (February 1986) v. 37(1) p. 1-6.

The following paper deals with the comparison of two methods for total-sulfur measurement in soils. The two methods (oxidation of total-S with a mixture of $NaNO_3/KNO_3$ and turbidimetric determination of SO_4^{2-}-S, and S-measurement with the Sulfur Determinator SC 132, Leco Corp.) show a clear correlation (r=0.68+++, y=50.15 + 0.23 x), but the Sulfur Determinator records 40% of the turbidimetrically determined sulfur-content only.

46656 (PB—86-208733/XAB) Avoiding failure of leachate-collection and cap-drainage systems. Report for September 1983-November 1985. Bass, J.M. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1986. 143p. NTIS, PC A07/MF A01.

Failure, caused by a variety of mechanisms, is common to drainage systems of all kinds. Leachate-collection and cap-drainage systems, which remove excess liquid from hazardous-waste land-disposal facilities, are no exception. Failure of these systems, however, may be a greater cause for concern than failure, for example, of agricultural drainage systems. This is especially true for leachate-collection systems at hazardous-waste-disposal facilities. Undetected failures may cause leachate to build up on top of the liner. This can lead to failure of the liner system and contamination of groundwater.

46657 Nuclear magnetic resonance spectroscopy of soils and related materials. Relaxation of ^{13}C nuclei in cross polarization nuclear magnetic resonance experiments. Wilson, M.A.; Pugmire, R.J.; Grant, D.M. (Univ. of Utah, Salt Lake City). *Organic Geochemistry;* 5: No. 3, 121-129(1983). Contract FG22-82PC50812.

Relaxation of carbon-13 nuclei in a peat, a soil, and three soil fractions was investigated in order to improve structural resolution and to investigate quantification of various carbon types. Rotating-frame spin-lattice relaxation times and transverse relaxation times are similar to those observed for coals. The rotating-frame relaxation times of carbons in different magnetic environments differ sufficiently that spectra can be obtained containing only nonprotonated carbon and methyl substituents if a 40-microsecond delay without decoupling is inserted into the pulse program before data acquisition (dipolar dephasing). Provided quantitative data is obtained in simple cross-polarization experiments and allowance is made for loss in signal intensity of nonprotonated carbon during dipolar dephasing, then the fraction of aromatic carbon which is protonated in the samples can be determined.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45725, 46234, 46235, 46252, 46566, 46579, 46649, 46651

46658 (EUR—10364-EN) Additional certification of the content (mass fraction) of iodine in two spiked samples of skim milk powder, CRM No. 150-151. Griepink, B. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 16p. Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

BCR information. Addition to report EUR--9251-EN (1984).

This report describes the additional certification of the iodine content in two skim milk powder reference materials, which are previously certified (Report EUR 9251) for their contents of Cd, Cu, Fe, Hg and Pb. The analyses were made using various independent methods applied by different laboratories. The results are given in detail.

46659 (INIS-mf—10174, pp XVII/99) Relation between tree ring records and short-term ^3H-contamination of precipitation. Rank, D.; Rajner, V.; Staudner, F.; Kozak, F.; Biro, T.; Golder, F. (Bundesversuchs- und Forschungsanstalt Arsenal, Vienna, Austria; Institute of Isotopes, Budapest, Hungary). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46660 (INIS-mf—10174, pp XIII/82) Radioactivity of frequently used building materials in Slovak Socialist Republic. Wirdzek, S.; Kazimir, D. (Ustav Radioekologie a Vyuzitia Jadrovej Techniky, Kosice, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46661 (INIS-mf—10174, pp XVI/97) Technologically enhanced levels of natural radioactivity studied by gamma-ray spectrometry. Braynik, D.; Kobal, I.; Korun, M.; Miklavzic, U. (J. Stefan Institute and Faculty of Electrotechnics E. Kardelj University, Ljubljana, Yugoslavia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46662 (INIS-mf—10174, pp XVIII/110) Large-volume low-level Ge(Li) spectrometry of nuclear power plants environmental samples. Slavik, O. (Vyskumny Ustav Jadrovych Elektrarni, Jaslovske Bohunice, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46663 (INIS-mf—10402, pp 29) Biological monitoring of radionuclides released from nuclear facilities. Jeffree, R.A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE86780480. (CONF-8508179—).

From 10. AINSE radiation biology conference; Lucas Heights, Australia (22 Aug 1985).

46664 (NIRS-RSD—69, pp 13-14) Strontium-90 and cesium-137 in milk (producing districts for domestic program) from June 1983 to September 1983. Environmental and dietary materials. Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in milk from producing districts for domestic program were determined using radiochemical analysis. Raw milk was collected from six sampling locations. Milk in a stainless steel pan or a porcelain dish was evaporated to dryness followed by carbonization and ashing. The maximum values of Sr-90 and Cs-137 were 2.8 +- 0.30 pCi/l and 1.8 +- 0.23 pCi/l, respectively, in milk collected from Aomori in February 1984.

46665 (NIRS-RSD—69, pp 15-16) **Strontium-90 and cesium-137 in milk (consuming districts) from May 1983 to May 1984. Environmental and dietary materials.** Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in milk from consuming districts were determined using radiochemical analysis. Commercial milk was purchased from 26 sampling locations. Milk in a stainless steel pan or a porcelain dish was evaporated to dryness followed by carbonization and ashing. The maximum value of Sr-90 was 2.3 +- 0.30 pCi/l in milk purchased from Fukushima in May 1983; the maximum value of Cs-137 was 3.3 +- 0.25 pCi/l in milk purchased from Tottori in February 1984.

46666 (NIRS-RSD—69, pp 17) **Strontium-90 and cesium-137 in milk (powderd milk). Environmental and dietary materials.** Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in powdered milk were determined using radiochemical analysis. Six brands of commercial milk were purchased as samples in consuming districts in May 1984. Milk in a stainless steel pan or a porcelain dish was evaporated to dryness followed by carbonization and ashing. The maximum values of Sr-90 and Cs-137 were 36.0 +- 1.3 pCi/kg and 190.) +- 2.0 pCi/kg, respectively, in milk manufactured by Meiji.

46667 (NIRS-RSD—69, pp 18-19) **Strontium-90 and cesium-137 in vegetables (producing districts) from November 1983 to March 1984. Environmental and dietary materials.** Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in vegetables from producing districts were determined using radiochemical analysis. Spinach, Japanese radish, cabbage, and Chinese cabbage were selected as the representatives for leaf vegetables and for non-starch roots, and were collected during the harvesting season from 12 sampling locations. After removing soil, the edible part of vegetable sample was dried and carbonized in a stainless steel pan or a porcelain dish. The maximum value of Sr-90 was 19.0 +- 0.80 pCi/kg in spinach collected from Kochi in January 1984; the maximum value of Cs-137 was 1.60 +- 0.26 pCi/kg in spinach collected from Kagoshima in November 1983.

46668 (NIRS-RSD—69, pp 20-21) **Strontium-90 and cesium-137 in vegetables (consuming districts) from November 1983 to February 1984. Environmental and dietary materials.** Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in vegetables from consuming districts were determined using radiochemical analysis. Spinach and Japanese radish were selected as the representatives for leaf vegetables and for non-starch roots, respectively, and were collected during the harvesting season from four sampling locations. After removing soil, the edible part of vegetable sample was dried and carbonized in a stainless steel pan or a porcelain dish. The maximum value of Sr-90 was 6.9 +- 0.36 pCi/kg in Japanese radish collected from Nagasaki in January 1984; the maximum value of Cs-137 was 0.50 +- 0.29 pCi/kg in spinach collected from Osaka in November 1983.

46669 (NIRS-RSD—69, pp 22-23) **Strontium-90 and cesium-137 in tea (Japanese tea). Environmental and dietary materials.** Jun 1984. NTIS (US Sales Only), PC A03/MF A01. File Number DE86780482.

In Radioactivity survey data in Japan.

Sr-90 and Cs-137 in Japanese tea were determined using radiochemical analysis. Five hundred grams of manufactured green tea was collected from six sampling locations in June 1984, carbonized and ashed in a stainless steel pan or a porcelain dish. The maximum value of Sr-90 was 88 +- 3.7 pCi/kg in tea collected from Kyoto; the maximum value of Cs-137 was 99.0 +- 3.60 pCi/kg collected from Kagoshima.

5106 Regulations

REFER ALSO TO CITATION(S) 45989

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 45672, 46244, 46640, 46753

46670 **(DOE/ER/60246—1) Hydrology and geochemistry of small tundra drainage basins in response to active layer disturbance. Progress report.** Rundle, A.S. (Ohio State Univ. Research Foundation, Columbus (USA)). Jun 1986. Contract FG02-84ER60246. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011485.

Hydrology of far northern drainage basins in which the shallow organic-rich surface layer overlies a permanently frozen substrate, is poorly known, yet is of great importance in evaluating natural stability and in predicting response to disturbances effecting flow and the distribution of nutrient and sedimentary ions. First-year study of a 2.5 km^2 watershed supports the primacy of the short duration melt-off in the yearly hydrologic/geochemical cycle. At this time basin storage capacity is minimum and total runoff carries with it a seasonal maximum of nutrient ions, suspended and dissolved solids. Subsequent to melt-off, base flow is high but decreases as thaw releases seasonally frozen water, including some temporarily stored melt-off. Spring storm events produce rapid peak discharges because of the low storage capacity in the catchment. Rare, high intensity, short duration storms in early season can produce discharges that rival diurnal peaks at melt-off. With activation of vegetation following melt-off, some nutrient ions are no longer detectable and pH becomes acid. Summer drought periods are common and if sufficiently protracted, reduce stream flow to barely measurable quantities. At such times hydrographs may show small diurnal fluctuations in response to evapotranspiration cycles. Ion concentrations show an increase as senescence commences in mid-August.

46671 **(DOE/RL/01830—T46) 360 year temperature and precipitation record for the Pasco Basin derived from tree-ring data.** Cropper, J.P.; Fritts, H.C. (Arizona Univ., Tucson (USA). Lab. of Tree-Ring Research). Aug 1986. Contract AC06-76RL01830. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014215.

Dendroclimatology, the study of past climatic variations by means of tree-ring analysis, is used to produce estimates of seasonal and annual temperature and precipitation from the 17th through 20th centuries. In this study these estimates, reconstructions, are derived in five different ways for regions that each include the Pasco Basin of south central Washington. The best of five sets of results were selected, based on the verification of the reconstructions with independent instrumental data. The reconstructed annual temperature of the Pasco Basin for the last three centuries was on the average 0.17 degrees Fahrenheit higher and had a standard deviation which was 4% larger than for the 20th century. The greatest reconstructed difference in the average temperature was in winter and the greatest reconstructed difference in the variance (standard deviation) was reconstructed in autumn. The average annual precipitation reconstructed for 1602 to 1900 was 0.32 inches higher than it has been in the 20th century. The change in average and standard deviation of reconstructed precipitation was greatest in autumn. Both the seasonal and annual reconstructions for temperature and precipitation exhibit large and persistent variations from

the mean which are often most pronounced in the 17th century. Droughts were more common starting with the last half of the 17th century, with values that sometimes exceeded the 20th-century maximum amounts and duration. While there are some similarities among the four seasons and two variables, many differences between the seasonal reconstructions exist. 28 refs., 6 figs., 6 tabs.

46672 El Nin-tildeo: An approach towards equilibrium temperature in the tropical eastern Pacific. Newell, R.E. (Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139). *Journal of Physical Oceanography;* **16**: No. 7, 1338-1342(Jul 1986).

A different view of El Nin-tildeo is proposed, namely, that it represents an approach towards the tropical equilibrium temperature of approximately 30° C, set essentially by evaporation, by the waters of the eastern tropical Pacific.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 45678, 46250, 46647, 46653, 46654, 46656, 46700

46673 (AD-A—168000/8/XAB) Environmental and water-quality operational studies. Initial evaluation of a computer algorithm for simulating anaerobic conditions in reservoirs and lakes. Final report. Zimmerman, Marc J. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab.). Feb 1986. 78p. NTIS, PC A05/MF A01.

A series of computer algorithms were developed to predict the concentrations of dissolved metals and nutrients in proposed and existing reservoirs. The algorithms, in the format of 13 subroutines, are incorporated in CE-QUAL-R1, the Corps of Engineers one-dimensional, numerical model of reservoir water quality. This evaluation documents procedures used early in the development and testing of the algorithms and has since led to modifications which have already improved CE-QUAL-R1 simulations in other applications. Field data derived from studies of DeGray Lake, Ark., provide the basis for calibrating and evaluating the algorithms. New model features specifically related to the simulation of anaerobic water-quality conditions include a simplified approach to initiate anaerobic processes, and simultaneous release from sediments of reduced materials and dissolved phosphorus. Oxidation and reduction processes in the water column are subject to the same constraints as those affecting sediment release. Two years of data from field studies, 1979 and 1980, were used to calibrate and evaluate simulations. In calibrating the model for assessing the new algorithms, sediment release rates were found to affect predictions most significantly. Although there were some discrepancies between observed and predicted conditions, trends and peak concentrations generally matched well. Further studies and applications of the model should help to assess its value as a tool in reservoir water quality management.

46674 (PB—86-190972/XAB) Sulfide precipitation of nickel and other heavy metals from single- and multi-metal systems. Final report. Bhattacharyya, D.; Chen, L.F. (Kentucky Univ., Lexington (USA). Dept. of Chemical Engineering). Apr 1986. 111p. NTIS, PC A06/MF A01.

Precipitation behavior of heavy metals (Ni, Co, Cd, Cu, and Zn) was studied extensively in single- and multi-metal systems. Kinetic studies showed that NiS oxidation (as a function of pH, oxygen, and reaction time) caused the dissolution of NiS. CoS precipitation would require high pH, short detention times, or closed reactors (under N_2 atmosphere). In the multi-metal systems without nickel, CdS, and ZnS precipitation were the same as in their single-metal systems; however, the precipitations were affected in nickel, CdS and ZnS precipitation were the same as in their single-metal systems; however, the precipitations were affected in nickel-containing systems because of NiS oxidation. Results of CdS precipitation from multi-metal systems (with or without nickel) were substantially better than the single-metal case.

46675 (PB—86-201340/XAB) Inventory of non-federally funded marine pollution research, development and monitoring activities: Northeast and Mid-Atlantic Region. Caton, G.M.; Opresko, D.M.; Weaver, R.S. (Oak Ridge National Lab., TN (USA)). Dec 1985. 244p. NTIS, PC A11/MF A01.

The Northeast and Mid-Atlantic inventory includes marine-pollution projects conducted in or are related to the states of Virginia, Maryland, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine. Projects related to outer continental shelf, oceanic, coastal, and estuarine areas are included. Some projects related to freshwater areas are also included where these were conducted for the purpose of determining sources of pollutants in estuarine and coastal areas or the effects on the marine environment resulting from changes in freshwater areas.

46676 (PB—86-206034/XAB) Nashua Impoundment sediment sampling, June 1985. Carleton, J.E. (Iowa Dept. of Water, Air and Waste Management, Des Moines (USA)). Oct 1985. 59p. NTIS, PC A04/MF A01.

The Iowa Department of Water, Air and Waste Management sampled the sediment of the Nashua Impoundment on the Cedar River in Chickasaw County during June, 1985. The sediment samples were analyzed using the Extraction Procedure (EP) Toxicity Test for eight heavy metals and six pesticides. The samples were also tested for total concentrations of cyanides, phenols, fluorides, chlorides, and eleven heavy metals. The sampling was done to determine if the sediment has been contaminated by chemicals that may have seeped out of the LaBounty hazardous waste site in Charles City, about ten miles upstream.

46677 (PB—86-207495/XAB) Estimated average annual alkalinity of six streams entering Deep Creek Lake, Garrett County, Maryland. Final report, May 1983-June 1984. Hodges, A.L. (Geological Survey, Dover, DE (USA). Water Resources Div.). Apr 1986. 73p. NTIS, PC A04/MF A01.

The study was done during 1983 to determine the sources of alkalinity to Deep Creek Lake, Maryland, and to make a rough estimate of the amount of alkalinity that enters the lake from six streams that drain carbonate and noncarbonate bedrock formations. Bedrock in the basin is predominantly sandstone and shale. Four streams draining the Greenbrier and two streams draining noncarbonate formations were sampled to assess the contribution of alkalinity to Deep Creek Lake. Average annual alkalinity of sampled streams ranged from 7.6 to 36.8 tons per year per square mile of drainage area. The average total alkalinity contributed to Deep Creek Lake by these streams is 161 tons per year as calcium carbonate. Inflow to streams from adjacent or underlying carbonate bedrock was apparent in several streams from increased values of pH and conductance.

46678 (PB—86-208709/XAB) USEPA (United States Environmental Protection Agency) method study 7. Analyses for trace elements in water by atomic absorption spectroscopy (direct aspiration) and colorimetry. Final report. Winter, J.A.; Britton, P.W. (Environmental Protection Agency, Cincinnati, OH (USA). Environmental Monitoring and Support Lab.). Jun 1986. 250p. (EPA/600/4—86/025). NTIS, PC A11/MF A01.

The report describes a study of ten elements: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, selenium and zinc, at trace levels in water. Six sample concentrates, each containing the ten trace elements, were sealed in glass ampuls, verified as homogeneous and stable over time, and provided to the analysts with instructions for sample preparation and analyses. Mean recovery, overall standard deviation, and single-analyst standard deviations were calculated for each element at each concentration and for the two water types.

46679 Vapor-aerosol physicochemical laboratory. Lore, J.D.; Skeen, L.M. (Oak Ridge Gaseous Diffusion Plant, TN). pp 9-16 of Analytical chemistry instrumentation. Laing, W.R. (ed.). Chelsea, MI; Lewis Publishers, Inc. (1986). (CONF-8510151—).

From 28. Oak Ridge National Laboratory conference on analytical chemistry; Knoxville, TN, USA (1 Oct 1985).

A laboratory capable of generating and characterizing vapors and aerosols at typical ambient concentration levels observed in chemical processing operations has been established at the ORGD Plant, operated by Martin Marietta Energy Systems, Inc. for the USDOE. A three-stage generation system (TSGS), originally developed by SRI, International, for the analytical methods validation studies sponsored by NIOSH, has been installed. Several aerosol/particulate monitors, controlled by microcomputers, provide the means for semi-real-time particle size and mass concentration measurements over the size range 0.1-10 μm. A full complement of chemical analysis instrumentation including laser Raman spectroscopy and gas chromatography-mass spectrometry is available for in-situ or sequential measurements of TSGS diluents.

46680 **Fate of particles and particle-reactive trace metals in coastal waters: radioisotope studies in microcosms.** Santschi, P.H.; Adler, D.M.; Amdurer, M. (Columbia Univ., Palisades, NY). pp 331-349 of Trace metals in sea water. Wong; Doyle; Bruland; Burton; Goldberg (eds.). New York, NY; Plenum Publishing Corporation (1983).

Many trace metals rapidly adsorb to suspended particles when introduced to the water column of coastal marine environments. The transport of these particles and particle-reactive trace metals from the water column to the sediments was studied using radiotracer techniques in large microcosm tanks simulating Narragansett Bay. Transfer rates of radioactive trace metals and plastic particles (tracer microspheres) to the sediments were much greater in mid-summer than in mid-winter. This coincided with an order-of-magnitude higher particle flux through the water column due to higher sediment-resuspension rates in the summer. Laboratory experiments using settling cylinders showed that interaction between the water column and bottom sediments greatly accelerates the deposition velocities of particles. Experiments using a zooplankton cage and sediment traps in the microcosm tanks indicated further that, in shallow marine environments, zooplankton filter feeding is a much-less-important transfer process than filter feeding by benthic organisms - which may greatly increase the removal rates of particles and particle-reactive trace metals from the water column during the summer. 39 references, 3 figures, 6 tables.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 45725, 46596, 46649, 46661, 46663

46681 (IAEA-TECDOC—362, pp 176-186) **Report of intercalibration exercises organized for the laboratories participating in the IAEA's co-ordinated research programme "Study of Radioactive Materials in the Baltic Sea" in 1981-1984.** Bojanowski, R.; Fukai, R.; Ballestra, S.; Vas, D. (International Atomic Energy Agency, Monaco-Ville, Monaco. Lab. of Marine Radioactivity). Jan 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE86703160. (CONF-8409349—).

From Final research co-ordination meeting on the study of radioactive materials in the Baltic Sea; Helsinki, Finland (24 Sep 1984).

The objectives of the intercalibration exercises were to offer the laboratories a possibility of cross-checking their analytical results, to discover and eliminate possible systematic errors and to give the data a common base in order to ensure their overall comparability. The concentrations of the radionuclides ^{40}K, ^{54}Mn, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{134}Cs, ^{137}Cs, ^{238}Pu, ^{239}Pu, ^{240}Pu and ^{241}Am were measured in the seawater samples SW-N-2 and SW-B-1, the sediment sample SD-N-1/1 and the seaweed Fucus vesiculosus sample AG-B-1. 6 refs, 9 tabs.

46682 (IAEA-TECDOC—362, pp 79-84) **Local patterns of the distribution of radionuclide releases from the Loviisa nuclear power station.** Ojala, J.; Ilus, E.; Sjoeblom, K.L. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jan 1986. NTIS (US Sales Only), PC A09/MF A01. File Number DE86703160. (CONF-8409349—).

From Final research co-ordination meeting on the study of radioactive materials in the Baltic Sea; Helsinki, Finland (24 Sep 1984).

The annual liquid discharges of radionuclides ^{58}Co, ^{60}Co and sup (110m)Ag from the Loviisa power station in 1981-1983 were about 10^9 Bqa^{-1}. The monthly concentrations of activation products in the seaweed Fucus vesiculosus varied between 0.5-120 Bq kg^{-1} for ^{58}Co, 0.5-170 Bq kg^{-1} for ^{60}Co and 0.5-130 Bq kg^{-1} for sup (110m)Ag on dry weight basis. The shape of the theoretical and experimental curves are in reasonable agreement with the time variation of releases. 7 refs., 4 figs., 2 tabs.

46683 (INIS-mf—10174, pp XIII/76) **^{222}Rn determination from total alpha-activity time relationship.** Hanslik, E.; Mansfeld, A. (Water Research Institute, Prague, Czechoslovakia). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

5205 Site Resource And Use Studies

46684 (DOE/BP/34796—1) **Feeding activity, rate of consumption, daily ration and prey selection of major predators in John Day Reservoir. Annual report.** Gray, G.A.; Palmer, D.E.; Hilton, B.L.; Connolly, P.J.; Hansel, H.C.; Beyer, J.M.; Lofy, P.T.; Duke, S.D.; Parsley, M.J.; Mesa, M.G. (Fish and Wildlife Service, Cook, WA (USA). Willard Field Station). Jul 1986. Contract AI79-82BP34796. 178p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE86014192.

The extent of predation on juvenile salmonids in John Day Reservoir was determined. Salmonids were the single most important food item by weight for northern squawfish (Ptychocheilus oregonensis) in the restricted zones at McNary tailrace and John Day forebay during all sampling periods. Salmonids accounted for 18.1% of the weight in the diet of walleyes (Stizostedion vitreum vitreum) in 1984 which was at least twice that found in previous years. In smallmouth bass (Micropterus dolomieui) salmonids contributed little to their diet whereas for channel catfish (Ictalurus punctatus) fish accounted for 64.1% of the weight in their diet with salmonids responsible for approximately half of this weight. An intensive search of the fisheries literature was conducted to review various fish capture and control techniques which might have potential as predation control measures for the major predators of juvenile salmonids in the Columbia River system. Most prey protection measures were judged to have high potential and direct predator control measures were judged to have moderate or low potential.

5206 Regulations

REFER ALSO TO CITATION(S) 45989

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 46751, 46755

5502 Biochemistry

REFER ALSO TO CITATION(S) 46492, 46493, 46743, 46744, 46751

5503 Cytology

46685 **Diffusion-limited forward rate constants in two dimensions: application to the trapping of cell surface receptors by coated pits.** Goldstein, B.; Griego, R.; Wofsy, C. (Los Alamos National Lab., NM). *Biophysical Journal;* **46**: 573-586(Nov 1984).

In this paper, the authors explore implications in receptor aggregation and internalization of the two types of recycling models that have been proposed for the maintenance of the coated pit concentration. In one model, coated pits alternate between accessible and inaccessible states at fixed locations on the cell surface, while in the other model, coated pits recycle to random locations on the cell surface. The authors consider receptors that are randomly inserted in the membrane, move by pure diffusion with diffusion coefficient D, and are instantly and irreversibly trapped when they reach a coated pit boundary (the diffusion limit). For such receptors, the authors calculate for each of the two models: the mean time tau to reach a coated pit, the forward rate constant k/sub +/ for the interaction of a receptor with a coated pit, and the fraction phi of receptors aggregated in coated pits. The authors show that for the parameters that characterize coated pits on human fibroblasts, the way in which coated pits return to the surface has a negligible effect on the values of tau, K/sub +/, and phi for mobile receptors, D Γ 1.0 x10^{-11} cm^2/s, but has a substantial effect for immobile receptors, D << 1 x 10^{-11} cm^2/s. The authors present numerical examples to show that it may be possible to distinguish between these models if one can monitor slowly diffusing receptors (D < 1 x 10^{-11} cm^2/s) on cells whose coated pits have relatively short lifetimes(∂ 1 min). Finally, the authors show that for the low-density lipoprotein (LDL) receptor on human fibroblasts (D = 4.5 x 10^{-11} cm^2/s), the predicted and observed values of /sub +/ and phi are in close agreement. Therefore, even for the slowly diffusing receptor, unaided diffusion as the transport mechanism of receptors to coated pits is consistent with measured rates of LDL internalization 36 references, 4 figures, 1 table.

5505 Metabolism

46686 (OEFZS-A—0756, pp 34) **Determination of iron levels in cutaneous porphyrias.** Kosa, A.; Horkay, I.; Altmann, H.; Teherani, D.K. (University Medical School, Debrecen, Hungary. Dept. of Dermatology; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

5506 Medicine

REFER ALSO TO CITATION(S) 45649, 46244, 46327, 46614, 46686, 46711, 46744

46687 **(BNL—38283) Non-invasive techniques for measuring body composition: state of the art and future prospects.** Cohn, S.H. (Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 20p. (CONF-8505112—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013909.

From 2. international symposium on the biology and toxicology of metals using nuclear analytical methods; Upton, NY, USA (20 May 1985).

In the past 20 years, in vivo analysis of body elements by neutron activation has become an important tool in medical research. In particular, it provides a much needed means to make quantitative assessments of body composition of human beings in vivo. The data are useful both for basic physiological understanding and for diagnosis and management of a variety of diseases and disorders. This paper traces the development of the in vivo neutron activation technique from basic systems to the present state of the art facilities. A scan of some of the numerous clinical applications that have been made with this technique, reveals the broad potentialities of in vivo neutron activation. The paper also considers alternative routes of future development and raises some of the questions now faced in making the techniques more widely available to both medical practitioners and medical investigators. In vivo neutron activation has opened a new era of both clinical diagnosis and therapy evaluation, and investigation into the modelling of body composition. The techniques are new, but it is already clear that considerable strides can be made in increasing accuracy and precision, increasing the number of elements susceptible to measurement, and reducing the dose required for the measurement. 18 refs., 7 figs.

46688 **(BNL—51997) Workshop on photon activation therapy: proceedings.** Fairchild, R.G. (ed.). (Brookhaven National Lab., Upton, NY (USA)). 18 Apr 1985. Contract AC02-76CH00016. 58p. (CONF-8504258—). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86013672.

From Workshop on photon activation therapy; Upton, NY, USA (18 Apr 1985).

This Workshop was held concurrently with an IAEA Research Coordination Meeting on Exploration of the Possibility of High-LET Radiation for Non-conventional Radiotherapy in Cancer. The Workshop on Photon Activation Therapy (PAT) was given as a special session on April 18, as it was thoght PAT might eventually be found to be attractive to developing countries, which is a major concern of the IAEA. An effort was made to bring together representatives of the various groups known to be actively working on PAT; these included investigators from Sweden and Japan as well as the US. It is hoped that this compendium of papers will be of use to those currently active in this developing field, as well as to those who might join this area of endeavor in the future.

46689 **(DOE/EV/03333—T6) Positron emission tomography (PET) analysis of the effects of auditory stimulation on the distribution of ^{11}C-N-methylchlorphentermine in the brain.** Paschal, C.B. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1986. Contract AC02-76EV03333. 83p. MIT, 77 Massachusetts Ave., Cambridge, MA 02139. File Number TI86012565.

Thesis.

This experimental work was launched to study how auditory stimulation effects blood flow in the brain. The technique used was Positron Emission Tomography (PET) with ^{11}C-N-methylchlorphentermine (^{11}C-NMCP) as the tracer. ^{11}C-NMCP acts as a molecular microsphere and thus measures blood flow. The objectives of this work were: to develop, test, and refine an experimental procedure, to design and construct a universally applicable positioning device, and to develop and test a synthesis for a radiopure solution of ^{11}C-NMCP; all were accomplished. PET was used to observe the brain distribution of ^{11}C-NMCP during binaural and monaural stimulation states. The data was analyzed by finding the signal intensity in regions of the image that represented the left and right interior colliculi (IC's), brain structures dedicated to the processing of auditory signals. The binaural tests indicated a statistically significant tendency for slightly higher concentration of the tracer in the left IC than in the right IC. The monaural tests combined with those of the binaural state were not solidly conclusive, however, three of the four cases showed a decrease in tracer uptake in the IC opposite the zero-stimulus ear, as expected. There is some indication that the anesthesia used in the majority of this work may have interferred with blood flow response to auditory stimulation. 39 refs., 17 figs., 3 tabs.

46690 **(DOE/EV/04533—8) Efficacy of clinical diagnostic procedures utilized in nuclear medicine. Final report, August 1977-November 30, 1983.** Saenger, E.L. (Cincinnati Univ. Medical Center, OH (USA)). Jun 1986. Contract AC02-77EV04533. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014661.

This report describes a study of 2023 patients comparing two methods of evaluating the efficacy of lung scanning in patients suspected of having pulmonary embolism (PE). Only the referring

physicians determined the probability of the most important (MI) and most likely (ML) diagnoses, and management, before and after lung scanning. A logistic regression model was developed for the probability of a signout diagnosis of PE. Equal patient groups tested the validity of the regression equations for the probability of PE both before and after the lung scan. The models developed on half the data (Group I) were then tested on the second half of the data set (Group II) to determine their ability to predict with similar results. This shows that the lung scan classifies PE and NOT PE patients well. Entropy minimax pattern detection (EMPD) attempts to predict the diagnosis and management from prior patient attributes. In 2023 cases, attributes alone could not iminate the use of lung scans for all patients. Comparing the two analytic methods, the predictive value, sensitivity, specificity and accuracy of each method are similar. However, EMPD predicts on a relatively small percent of cases (40% prior and 715 post scan) while logistic regression equations predict on 100% of cases. 29 refs., 2 figs., 16 tabs.

46691 (INIS-mf—10173, pp 26) **Development studies of a new gamma camera for positron emission tomography.** Schotanus, P.; Eijk, C.W.E. van; Hollander, R.W.; Pijpelink, J. (Technische Hogeschool Delft, Netherlands). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46692 (INIS-mf—10173, pp 27) **Multiwire detectors for use in time-resolved experiments from muscle.** Faruqi, A.R. (Medical Research Council, Cambridge, UK). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

46693 (OEFZS-A—0686, pp 28) **Open questions in reaction mechanism of radontherapy.** Mukherjee, R.; Altmann, H. (International Atomic Energy Agency, Vienna, Austria; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-8506290—Absts.; BL—508/85).

From International symposium on drug therapy and alternative therapy methods; Sopron, Hungary (21 Jun 1985).

46694 (OEFZS-A—0686) **International Symposium on drug therapy and alternative therapy methods.** (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jun 1985. 42p. (In German and English). (CONF-8506290—Absts.; BL—508/85). Institute for Biology, OEFZS, A-2444 Seibersdorf, Austria.

From International symposium on drug therapy and alternative therapy methods; Sopron, Hungary (21 Jun 1985).

This report is a collection of abstracts of presentations held at the International Symposium on drug therapy and alternative therapy methods. Some of these abstracts are within the subject scope of INIS and these abstracts are treated separately for INIS. A publication of proceedings of this conference is planned for the end of 1986.

46695 (OEFZS-A—0686, pp 11-12) **Control of ion transport in the heart muscle by new antiarrhythmicas.** Somogyi, J.; Ver, A.; Muellner, N.; Turi, A.; Kovacs, T.; Manyai, S. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary. 2. Kemiai Biokemiai Intezet; Orvostudomanyi Egyetem, Debrecen, Hungary; EGIS Pharmazeutische Werke, Budapest, Hungary). Jun 1985. (In German). Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-8506290—Absts.; BL—508/85).

From International symposium on drug therapy and alternative therapy methods; Sopron, Hungary (21 Jun 1985).

46696 (OEFZS-A—0686, pp 37) **Medium power YAG laser treatment of rheumatoid arthritis.** Barabas, K.; Balint, G.; Meretey, K.; Reviczky, A.; Toeroes, E.; Dunky, A.; Eberl, R.; Altmann, H.; Pinterits, G.; Topaloglou, A. (Orszagos Reuma- es Fizioterapias Intezet, Budapest, Hungary. Koezponti Izotoplaboratorium; Krankenhaus der Stadt Wien-Lainz, Austria. 2. Medizinische Abt.; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Jun 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-8506290—Absts.; BL—508/85).

From International symposium on drug therapy and alternative therapy methods; Sopron, Hungary (21 Jun 1985).

46697 **Efficiency index: a new parameter to define breathing patterns during dynamic Xe-127 ventilation studies.** Slosman, D.; Susskind, H.; Bossuyt, A.; Tang, Y.N.; Brill, A.B. (Brookhaven National Lab., Upton, NY). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **45**: No. 3, 392(1 Mar 1986). (CONF-8604222—).

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

Ventilation imaging can be improved by gating scintigraphic data with the respiratory cycle using temporal Fourier analysis (TFA) to quantify the temporal behavior of the ventilation. Sixteen consecutive images, representing equal-time increments of an average respiratory cycle, were produced by TFA in the posterior view on a pixel-by-pixel basis. An Efficiency Index (EFF), defined as the ratio of the summation of all the differences between maximum and minimum counts for each pixel to that for the entire lung during the respiratory cycle, was derived to describe the pattern of ventilation. The gated ventilation studies were carried out with Xe-127 in 12 subjects: normal lung function (4), small airway disease (2), COPD (5), and restrictive disease (1). EFF for the first three harmonics correlated linearly with FEV1 ($r = 0.701$, $p < 0.01$). This approach is suggested as a very sensitive method to quantify the extent and regional distribution of airway obstruction.

46698 **No-carrier-added [^{18}F]-N-methylspiroperidol.** Shiue, C.Y.; Fowler, J.S.; Wolf, A.P. (to Dept. of Energy). US Patent Application 6-784,149. 4 Oct 1985. 24p. Contract AC02-76CH00016. DE86013761 NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013761.

The present invention is directed to the synthesis of a radioligand, labeled with a positron emitting radionuclide which is suitable for dynamic studies in humans using positron emission transaxial tomography. No-carrier-added (NCA) [^{18}F]-N-methylspiroperiodl is prepared from four different sustrates: p-nitrobenzonitrile, cyclopropyl p-nitrophenyl ketone, p-cyclopropanoyl-N,N,N-trimethylanilinium iodide and p-cyclopropanoyl-N,N,N-trimethylanilinium perchlorate. The process for the production of NCA [^{18}F]-N-methylspiroperidol is a nucleophilic aromatic substitution reaction. Furthermore, the compound of this invention is shown to be effective as a new drug of choice for in vivo examination of dopamine binding sites in a human brain. In particular, this drug is primarily useful in the noninvasive technique of positron emission transaxial tomography (PETT).

46699 **Method for the simultaneous preparation of radon-211, xenon-125, xenon-123, astatine-211, iodine-125 and iodine-123.** Mirzadeh, S.; Lambrecht, R.M. (to Dept. of Energy). US Patent Application 6-750,123. 1 Jul 1985. 28p. Contract AC02-76CH00016. DE86013698 NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013698.

The invention relates to a practical method for commercially producing radiopharmaceutical activities and, more particularly, relates to a method for the preparation of about equal amount of Radon-211 (^{211}Rn) and Xenon-125 (^{125}Xe) including a one-step chemical procedure following an irradiation procedure in which a selected target of Thorium (^{232}Th) or Uranium (^{238}U) is irradiated. The disclosed method is also effective for the preparation in a one-step chemical procedure of substantially equal amounts of high purity ^{123}I and ^{211}At. In one preferred arrangement of the invention almost equal quantities of ^{211}Rn and ^{125}Xe are prepared using

a onestep chemical procedure in which a suitably irradiated fertile target material, such as thorium-232 or uranium-238, is treated to extract those radionuclides from it. In the same one-step chemical procedure about equal quantities of ^{211}At and ^{123}I are prepared and stored for subsequent use. In a modified arrangement of the method of the invention, it is practiced to separate and store about equal amounts of only ^{211}Rn and ^{125}Xe, while preventing the extraction or storage of the radionuclides ^{211}At and ^{123}I.

5507 Microbiology

REFER ALSO TO CITATION(S) 45764

46700 (DOE/ER—0289) Microbial metabolism of aromatic compounds under anaerobic conditions. Berry, D.F.; Francis, A.J.; Bollag, J.M. (Pennsylvania State Univ., University Park (USA). Soil Microbiology Lab.; Brookhaven National Lab., Upton, NY (USA). Applied Science Dept.). Jun 1986. Contract AC02-76CH00016. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014211.

Recent studies on the anaerobic biodegrıstation of haloaromatic and aromatic compounds clearly demonstrate the importance of anaerobic microbial transformations of organic compounds in anoxic environments. This paper presents a critical review of the available scientific information on the anaerobic microbial metabolism of homo- and heterocyclic aromatic compounds, with emphasis on various anaerobic microbial processes and metabolic pathways.

5508 Morphology

REFER ALSO TO CITATION(S) 46737

5510 Physiological Systems

REFER ALSO TO CITATION(S) 46689

46701 Effect of photoperiod on gibberellin biosynthetic enzymes in spinach. Gilmour, S.J.; Bleecker, A.B.; Zeevaart, J.A.D. (Michigan State Univ., East Lansing). *Plant Physiology;* **80**: No. 4, 33(Apr 1986). Contract AC02-76ER01338.

From Annual meeting of the American Society of Plant Physiologists; Baton Rouge, LA, USA (8-12 Jun 1986).

The photoperiodic control of stem elongation in spinach, a long day (LD) rosette plant, is mediated by gibberellins (GAs). The early 13-hydroxylated GA biosynthetic pathway from GA_{12} to GA_{20} operates in spinach: $GA_{12} \rightarrow GA_{53} \rightarrow GA_{44} \rightarrow GA_{19} \rightarrow GA_{20}$. Two enzymes of this pathway, those converting GA_{53} to GA_{44} (GA_{53} oxidase) and GA_{19} to GA_{20} (GA_{19} oxidase), are regulated by light. The enzyme converting GA_{44} to GA_{19} (GA_{44} oxidase) is not light-regulated. In the light GA_{53} and GA_{19} oxidase activities are increased, therefore causing the GA biosynthetic pathway to be turned on. This leads to the production of an active GA in LD, which causes an increase in stem elongation. Two the enzymes, GA_{44} and GA_{53} oxidases, can be separated from one another by anion exchange HPLC. Estimates of the molecular weights of these two enzymes based on gel filtration HPLC will be reported.

46702 Mutants of Arabidopsis as tools for physiology and molecular biology. Somerville, C.R.; Artus, N.; Browse, J.; Caspar, T.; Estelle, M.; Haughn, G.; Kunst, L.; Martinez, J.; McCourt, P.; Moffatt, B. (Michigan State Univ., East Lansing). *Plant Physiology;* **80**: No. 4, 2(Apr 1986).

From Annual meeting of the American Society of Plant Physiologists; Baton Rouge, LA, USA (8-12 Jun 1986).

The authors discuss the importance of developing a facile system for genetic analysis in higher plants which can be used to approach problems specific to plant biology in much the same way that molecular genetic approaches have been used in other classes of organisms such as yeast and Drosophila. Toward this end, they have developed methods for the isolation and analysis of mutants of Arabidopsis with specific alterations in photosynthesis, photorespiration, starch metabolism, lipid metabolism, purine metabolism, amino acid metabolism and phytohormone responses. The utility of this collection of mutants for studying problems in physiology and biochemistry is illustrated with selected examples.

46703 Oat tonoplast H^+/Ca^{2+} antiport is a reversible, electrogenic transport system. Schumaker, K.S.; Sze, H. (Univ. of Maryland, College Park). *Plant Physiology;* **80**: No. 4, 25(Apr 1986). Contract AS05-82ER13015.

From Annual meeting of the American Society of Plant Physiologists; Baton Rouge, LA, USA (8-12 Jun 1986).

The oat root tonoplast H^+/Ca^{2+} antiport was characterized directly using an artificially generated pH gradient (acid inside). Tonoplast vesicles are isolated from a 0/4% dextran interface. These membranes are enriched in ATPase activity and ATP-dependent 45-Ca^{2+} uptake that are nitrate-sensitive and azide-resistant. Ca^{2+} uptake is coupled to the efflux of H^+ as increasing Ca^{2+} concentrations could progressively dissipate a pH gradient. The Km of the antiport for Ca^{2+} is 10 μM. La^{3+} (50 μM), ruthenium red (25 μM) and N,N'-dicyclohexylcarbodiimide (3 μM) inhibited Ca^{2+} uptake but had no effect on the formation of ΔpH. The H^+/Ca^{2+} is electrogenic (generating a positive interior potential) as demonstrated by the uptake of [14-C]SCN^-. Furthermore, an artificially imposed membrane potential (interior negative) stimulated Ca^{2+} uptake while a positive potential decreased uptake. The antiport is reversible as a Ca^{2+} gradient (Ca^{2+}/sub in/ > Ca^{2+}/sub out/) could drive formation of a pH gradient (acidic inside).

46704 Frequency content of forced exhalations of normal rats. Mauderly, J.L.; Seiler, F.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM). *Federation Proceedings, Federation of American Societies for Experimental Biology;* **45**: No. 3, 312(1 Mar 1986). (CONF-8604222—). Contract AC04-76EV01013.

From 70. annual meeting of the Federation of American Society for Experimental Biology; St. Louis, MO, USA (13 Apr 1986).

The frequency content of the flow-time relationship during forced exhalation determines the equipment response characteristics required for measurements of small animals. Flow-time data were collected by flow plethysmography at 1 msec intervals during single forced exhalations of 22 male and 22 female 14 wk old, healthy, anesthetized F344/N rats. Lungs of apneic rats were inflated to 30 cm H_2O transpulmonary pressure and deflated at -50 cm H_2O airway pressure. Similar data were collected from the testing system without a rat. Amplitudes and phases at 4 Hz intervals from 4 to 96 Hz Hz were calculated by LaPlace transform. Amplitudes were related to lung volume. Cumulative percentages of the total amplitude to 96 Hz were similar for males and females at each frequency. Of the total cumulative amplitude to 96 Hz, 50%, 95%, and 99% was contributed by frequencies lower than 12, 52, and 76 HZ, respectively. Amplitudes of rats exceeded those of the system alone between 20 and 40 Hz, due to lung elastic recoil. Thus, systems capable of measuring events of frequencies up to 50 Hz should be adequate for evaluating forced exhalations of rats.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 46652

46705 (LA-UR—86-1596) Canopy hot-spot as crop identifier. Gerstl, S.A.W.; Simmer, C.; Powers, B.J. (Los Alamos National Lab., NM (USA). Theoretical Div.). May 1986. Contract W-7405-ENG-36. 10p. (CONF-860888—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86011258.

From International symposium on remote sensing for resources development and environmental management; Enschede, Netherlands (25 Aug 1986).

Illuminating any reflective rough or structured surface by a directional light source results in an angular reflectance distribution that shows a narrow peak in the direction of retro-reflection. This is called the Heiligenschein or hot-spot of vegetation canopies and is caused by mutual shading of leaves. The angular intensity distribution of the hot-spot, its brightness and slope, are therefore indicators of the plant's geometry. We propose the use of hot-spot characteristics as crop identifiers in satellite remote sensing because the canopy hot-spot carries information about plant stand architecture that is more distinctive for different plant species than, for instance, their spectral reflectance characteristics. A simple three-dimensional Monte Carlo/ray tracing model and an analytic two-dimensional

model are developed to estimate the angular distribution of the hot-spot as a function of the size of the plant leaves. The results show that the brightness-distribution and slope of the hot-spot change distinctively for different leaf sizes indicating a much more peaked maximum for the smaller leaves.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 46708, 46716, 46717, 46720, 46721, 46722, 46723, 46724, 46725, 46726, 46727, 46728

46706 **(ANL/EES-TM—308) Weldon Spring historical dose estimate.** Meshkov, N.; Benioff, P.; Wang, J.; Yuan, Y. (Argonne National Lab., IL (USA)). Jul 1986. Contract W-31-109-ENG-38. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE86014085.

This study was conducted to determine the estimated radiation doses that individuals in five nearby population groups and the general population in the surrounding area may have received as a consequence of activities at a uranium processing plant in Weldon Spring, Missouri. The study is retrospective and encompasses plant operations (1957-1966), cleanup (1967-1969), and maintenance (1969-1982). The dose estimates for members of the nearby population groups are as follows. Of the three periods considered, the largest doses to the general population in the surrounding area would have occurred during the plant operations period (1957-1966). Dose estimates for the cleanup (1967-1969) and maintenance (1969-1982) periods are negligible in comparison. Based on the monitoring data, if there was a person residing continually in a dwelling 1.2 km (0.75 mi) north of the plant, this person is estimated to have received an average of about 96 mrem/yr (ranging from 50 to 160 mrem/yr) above background during plant operations, whereas the dose to a nearby resident during later years is estimated to have been about 0.4 mrem/yr during cleanup and about 0.2 mrem/yr during the maintenance period. These values may be compared with the background dose in Missouri of 120 mrem/yr.

46707 **(DOE/ER/60393—1) Mutagenic effect of radionuclides incorporated into DNA of Drosophila melanogaster. Technical progress report, December 15, 1985-July 15, 1986.** Lee, W.R. (Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology). 1986. Contract FG05-86ER60393. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014680.

This project compares the mutagenic effect of ionizing radiation from tritium to that of x-ray. Mutants are described at the molecular level after having been characterized by classical genetic techniques in Drosophila melanogaster, therefore tying together the molecular studies with previous work in mutagenesis. The objectives of this project are to analyze x-ray and tritium induced mutants by "walking down" the chromosomes and studying the frequency of breaks that are not associated with the gene used in screening for the mutants, to study the molecular effect of these mutants in heterozygotes with the aim of developing methods of detecting mutants in heterozygotes that may be applicable to human populations, and to induce mutants from tritium beta radiation and analyze them at the molecular level. 9 refs., 4 figs.

46708 **(DOE/ER/60402—1) Radiation physics, biophysics, and radiation biology. Progress report, December 1, 1985-November 30, 1986.** Hall, E.J. (Columbia Univ., New York (USA). Radiological Research Lab.). Jul 1986. Contract FG02-86ER60402. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86013991.

This is the annual report of the Radiological Research Laboratory of the Department of Radiation Oncology, Columbia University. The bulk of the research of the Laboratory involves basic and fundamental aims, not confined to radiotherapy. Research carried out in the Laboratory covers the determination of microdosimetry quantities, computer simulation of particle tracks, determination of oncogenic transformation, and the transfection of DNA into cells. The Hallmark of the Laboratory is the interaction between physics and biology.

46709 **(DOE/EV/10417—1) Immunochemical approach to the study of DNA damage and repair. Technical progress report.** (New York Medical Coll., NY (USA)). 1986. Contract AC02-80EV10417. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014813.

We are studying damages that have been shown to be stable radiolysis products found in x-irradiation DNA and thus products that have potential biological consequences. Four thymine ring saturation or fragmentation products were chosen as models for pyrimidine radiolysis products. The first product we synthesized and to which antibodies were elicited was thymine glycol. Thymine glycols are the major stable radiolysis products produced in DNA x-radiation in vitro. Although they retain base pairing characteristics, the stacking properties of thymine glycols are altered due to the saturation of the 5.6 double bond. Thymine glucol is also a useful model because alternative assay proceudres are available and they can selectively be produced in DNA by osmium tetroxide oxidation allowing the development of standards for subsequent measurement of DNA damage in x-irradiated DNA. We have also raised antibodies to dihydrothymine, a major radiolysis product produced in NDA under anaerobic conditions, to 5-hydroxy-5-methylhydantoin, the second most predominant stable radiolysis product producted under aerobic conditions, and to urea, a totally non-instructive DNA fragmentation product of thymine hydroperoxides. 29 refs., 2 figs.

46710 (INIS-mf—10174, pp XVIII/112) **Experiences from laboratory of internal contamination measurement in Nuclear Research Institute, Rez near Praque.** Vejnar, J.; Neuzil, J. 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46711 (INIS-mf—10174, pp vp) **Concentrations of ^{222}Rn and its short-lived decay products in a number of Greek radon spas.** Kritidis, P.; Angelov, P. (National Research Foundation, Athens, Greece). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46712 (INIS-mf—10402, pp 31) **SNIF - the standard neutron irradiation facility at Lucas Heights.** Boldeman, J.W.; Cohen, D.D.; Katsaros, A.; Lavin, M.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights; Australian Inst. of Nuclear Science and Engineering, Lucas Heights; Queensland Univ., St. Lucia, Australia. Dept. of Biochemistry). Aug 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE86780480. (CONF-8508179—).

From 10. AINSE radiation biology conference; Lucas Heights, Australia (22 Aug 1985).

46713 **(NVO—232-Rev.3) Radiation safety manual for the Nevada Test Site. Revision 3.** (Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA); USDOE Nevada Operations Office, Las Vegas). Jun 1986. Contract AC08-76NV00410. 304p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE86014101.

This report defines minimum radiation protection standards for test site personnel and DOE/NV contractor personnel offsite. It establishes, under Department of Energy policy, responsibilities for radiological safety for NTS operations as functional assignments, and guidelines for radiation protection standards, personnel dosimetry and monitoring, area control, protective equipment and safety requirements, radioactive material control, transfer and shipment, citing requirements and codes, and standards of pertinent federal agencies.

46714 (OEFZS-A—0686, pp 38) **DNA metabolism of spleen cells of mice after HeNe laser irradiation.** Topaloglou, A.; Pinterits, G.; Altmann, H.; Barabas, K.; Dunky, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie; Orszagos Reuma- es Fizioterapias Intezet, Budapest, Hungary. Koezponti Izotoplaboratorium; Krankenhaus der Stadt Wien-Lainz, Austria. 2. Medizinische Abt.). Jun 1985. (In German). Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-8506290—Absts.; BL—508/85).

From International symposium on drug therapy and alternative therapy methods; Sopron, Hungary (21 Jun 1985).

46715 (OEFZS-A—0756, pp 1) **Poly (ADP-ribose) present at the replication origin of DNA.** Altmann, H.; Topaloglou, A.; Brkic, G. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie; Institut za Nuklearne Nauke Boris Kidric, Belgrade, Yugoslavia). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46716 (OEFZS-A—0756, pp 4) **Time dependence of biochemical parameters during induction of DNA repair.** Vincze, I.; Gueth, L.; Karcagi, V.; Puespoeky, J.; Weniger, P.; Altmann, H. (National Institute of Hygiene, Budapest, Hungary. Dept. of Biochemistry; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46717 (OEFZS-A—0756, pp 6) **Influence of radiation and 3-methoxybenzamide on DNA rejoining.** Bhatia, A.L. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46718 (OEFZS-A—0756, pp 7) **Simultaneous determination of mono- and poly(ADP-ribose) in vivo by tritium labelling and direct HPLC separation.** Hakam, A.; McLick, J.; Kun, E. (California Univ., San Francisco, USA. Cardiovascular Research Inst.). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46719 (OEFZS-A—0756, pp 8) **Hormonal imprinting and poly(ADP-ribose)-synthesis.** Toeroek, O.; Csaba, G.; Altmann, H. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46720 (OEFZS-A—0756, pp 9) **Poly(ADP-ribose)-synthesis and DNA metabolism in lymphocytes of hypertension patients.** Varga, L.; Simon, E.; Domjan, G.; Topaloglou, A.; Phoung, P.T.; Altmann, H. (Staatliches Sanatorium, Sopron, Hungary; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. (In German). Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46721 (OEFZS-A—0756, pp 10) **Lymphocytic subsets of C57Bl mice after whole body irradiation and application of par-polymerase modifying factors.** Tuschl, H.; Kovac, R. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46722 (OEFZS-A—0756, pp 11) **Modification of mutagenesis and repair processes by human interferons.** Zasukhina, G. (Akademiya Meditsinskikh Nauk SSSR, Moscow. Inst. Meditsinskoj Genetiki). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46723 (OEFZS-A—0756, pp 12-13) **Inhibition of lymphocyte activation by serum lipoproteins: effect of VLDL and LDL.** Somogyi, J.; Koevecses, M.; Szollar, L.; Szamel, M. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46724 (OEFZS-A—0756, pp 15-16) **Effect of free radical scavengers on lymphocyte blast transformation.** Feher, J.; Vallent, K.; Lang, I.; Gonzales-Cabello, R.; Gergely, P.; Varga, L. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary; Staatliches Sanatorium, Sopron, Hungary). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46725 (OEFZS-A—0756, pp 18) **Appearance of methylguanine in the DNA of CHO-cells before and after methylnitrosoures therapy.** Kutscher, R. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. (In German). Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46726 (OEFZS-A—0756, pp 20-22) **Metabolism of RNA primer in replicative DNA synthesis.** Banfalvi, G.; Antoni, F.; Sarkar, N. (Semmelweis Orvostudomanyi Egyetem, Budapest, Hungary; Boston Biomedical Research Inst., MA, USA; Harvard Medical School, Boston, MA, USA). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46727 (OEFZS-A—0756, pp 26-27) **Formation of covalent DNA adducts in activated drug metabolizing systems.** Schoket, B.; Vincze, I.; Weniger, P.; Altmann, H. (National Institute of Hygiene, Budapest, Hungary. Dept. of Biochemistry; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46728 (OEFZS-A—0756, pp 33) **Trace elements and excision repair in light sensitive skin diseases.** Horkay, I.; Kosa, A.; Nagy, E.; Altmann, H.; Teherani, D.K. (University Medical School, Debrecen, Hungary. Dept. of Dermatology; Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Biologie). Dec 1985. Institute for Biology, OEFZS, A-2444, Seibersdorf, Austria. (CONF-851281—Absts.; BL—538/852).

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

46729 **(OEFZS-A—0756) DNA metabolism influencing factors.** (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Nov 1985. 34p. (In German and English). (CONF-851281—Absts.; BL—538/852). Institute for Biology, OEFZS, A-2444 Seibersdorf, Austria.

From DNA metabolism influencing factors; Vienna, Austria (5 Dec 1985).

This report is a collection of abstracts of presentations held at the Symposium 'DNA metabolism influencing factors'. Some of these abstracts are within the subject scope of INIS and these abstracts are treated separately for INIS. A publication of proceedings of this conference is planned for the end of 1986.

46730 **(PNL-SA—13454) Two example applications of optimization techniques to US Department of Energy contractor radiation protection programs.** Merwin, S.E.; Martin, J.B.; Selby, J.M.; Vallario, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1986. Contract AC06-76RL01830. 15p. (CONF-860315—1; IAEA-SM—285/21). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013340.

From International symposium on the optimization of radiation protection; Vienna, Austria (10 Mar 1986).

Six numerical examples of optimization of radiation protection are provided in the appendices of ICRP Publication 37. In each case, the calculations are based on fairly well defined parameters and assumptions that were well understood. In this paper, we have examined two numerical examples that are based on empirical data and less certain assumptions. These examples may represent typical applications of optimization principles to the evaluation of specific elements of a radiation protection program. In the first example, the optimum bioassay frequency for tritium workers was found to be once every 95 days, which compared well with ICRP Publication 10 recommendations. However, this result depended heavily on the assumption that the value of a potential undetected rem was US $1000. The second example showed that the optimum frequency for recalibrating Cutie Pie (CP) type ionization chamber survey instruments was once every 102 days, which compared well with the Hanford standard frequency of once every 90 days. This result depended largely on the assumption that an improperly operating CP instrument could lead to a serious overexposure. These examples have led us to conclude that optimization of radiation protection programs must be a very dynamic process. Examples must be recalculated as empirical data expand and improve and as the uncertainties surrounding assumptions are reduced.

5602 Thermal Effects

46731 **(CONF-8508192—1) Basic concepts in freezing cells.** Mazur, P. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014216.

From 1. international conference on deep freezing of boar semen; Uppsala, Sweden (25 Aug 1985).

Freezing involves the lowering of temperature and the formation of ice. Most cells have not been found to be sensitive to the former; rather injury is a consequence of the removal of water from the system in the form of ice. Some cells such as boar sperm and those of many tropical crops are susceptible to even short-term lowering of temperature to near O°C. This susceptiblity, which is independent of the rate of temperature drop, is defined as chilling injury. Other cells are injured by chilling only if the rate of cooling is high, a phenomenon referred to as thermal shock. This paper discusses the physical-chemical events during freezing and on freezing injury will assume that lowered temperature per se is not injurious.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 45611, 46223, 46226

46732 **(BNL—38355) Correlation of trace elements in hair with colon cancer.** Kwiatek, W.M.; Cholewa, M.; Kajfosz, J.; Jones, K.W.; Shore, R.E.; Redrick, A.L. (Brookhaven National Lab., Upton, NY (USA); New York Univ., NY (USA). Medical Center). 1986. Contract AC02-76CH00016. 21p. (CONF-8606181—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014172.

From 4. international conference on particle induced X-ray emission and its analytical applications; Tallahassee, FL, USA (9 Jun 1986).

The trace element content of 116 hair samples from patients with colon cancer and from referent series of patients who had a variety of other diseases were measured using proton-induced x-ray emission (PIXE). The patients had been on largely uncontrolled diets, and the interest was whether there were differences in trace element concentrations attributable to the effects of colon cancer. The concentrations of K, Ca, Mn, Fe, Cu, Zn, Se, Br, and Rb were determined using a beam of 2.5-MeV protons. Minimum detectable limits (MDL) of 0.3 ppM were obtained for Zn and Se. Cluster analysis of the data set did not reveal any significant differences between the cancer and control groups. Mean values and ranges obtained for the elemental concentrations show good agreement with other published determinations. 20 refs., 3 figs., 3 tabs.

46733 **(BNL—38357) Elemental concentrations in bones from an ancient Egyptian mummy and from a recent man.** Cholewa, M.; Kwiatek, W.M.; Jones, K.W.; Schidlovsky, G.; Paschoa, A.S.; Miller, S.C.; Pecotte, J. (Brookhaven National Lab., Upton, NY (USA); Utah Univ., Salt Lake City (USA)). Jun 1986. Contract AC02-76CH00016. 12p. (CONF-8606181—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014127.

From 4. international conference on particle induced X-ray emission and its analytical applications; Tallahassee, FL, USA (9 Jun 1986).

Differences in elemental concentrations in bones taken from an ancient Egyptian mummy and a contemporary man were investigated by using proton induced x-ray emission (PIXE) in combination with Rutherford backscattering (RBS). Remarkable differences were noticed in the Fe/Ca and Pb/Ca relative concentrations, which were consistently higher in the contemporary man. 5 refs., 2 figs., 2 tabs.

46734 **(BNL—38373) In vivo monitoring of toxic metals: assessment of neutron activation and x-ray fluorescence techniques.** Ellis, K.J. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 23p. (CONF-8606152—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014129.

From 17. international Rochester conference; Rochester, NY, USA (2 Jun 1986).

To date, cadmium, lead, aluminum, and mercury have been measured in vivo in humans. The possibilities of monitoring other toxic metals have also been demonstrated, but no human studies have been performed. Neutron activation analysis appears to be most suitable for Cd and Al measurements, while x-ray fluorescence is ideally suited for measurement of lead in superficial bone. Filtered neutron beams and polarized x-ray sources are being developed which will improve in vivo detection limits. Even so, several of the current facilities are already suitable for use in epidemiological studies of selected populations with suspected long-term low-level "environmental" exposures. Evaluation and diagnosis of patients presenting with general clinical symptoms attributable to possible toxic metal exposure may be assisted by in vivo examination. Continued in vivo monitoring of industrial workers, especially follow-up measurements, will provide the first direct assessment of changes in body burden and a direct measure of the biological lifetimes of these metals in humans. 50 refs., 4 figs., 2 tabs.

46735 (BNL—38374) Logistic regression analysis of cadmium-induced renal abnormalities. Ellis, K.J.; Yuen, K.; Cohn, S.H. (Brookhaven National Lab., Upton, NY (USA)). Feb 1986. Contract AC02-76CH00016. 20p. (CONF-860297—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014174.

From 5. international cadmium conference; San Francisco, CA, USA (1 Feb 1986).

Cases of renal dysfunction associated with cadium exposure have been reported in Belgium, Great Britian, Japan, United States, and Sweden. Indirect estimates of body burden were often based on the measurement of environmental exposure conditions or on tissue concentrations in urine, blood, saliva, or hair clippings. More recently, however, the direct in vivo assessment of liver and kidney cadmium burden in humans has provided additional data. Sufficient data on humans does exist, however, to make reasonable estimates of the increased risk for cadmium-induced renal dysfunction. In the present paper, a linear logistic regression model has been developed on the basis of liver and kidney cadmium burden. These relationships are discussed with respect to the concept of a critical concentration for the renal cortex. 14 refs., 3 figs., 2 tabs.

46736 (CONF-8606161—1) Complex mixtures: comparative chemical and toxicological characterization. Stamoudis, V.C.; Picel, K.C.; Haugen, D.A.; Vlastnik, V.J. (Argonne National Lab., IL (USA)). 1986. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014205.

From Conference on health and environmental effects of complex chemical mixtures; Delavan, WI, USA (16 Jun 1986).

Chemical and toxicological data were obtained for three energy-related materials, a by product oil from the Great Plains commercial gasifier (GPGG); a comparative research material, CRM-1, from the SRC-II coal-liquefaction process; and a shale oil standard reference material (SRM No. 1580) from the National Bureau of Standards. The materials are compared on the basis of mass and mutagenicity balances for major chemical fractions produced from standardized fractionation procedures. 2 tabs.

46737 (DOE/EV/03139—51) Embryo culture in teratological surveillance and serum proteins in development. Final technical report. Klein, N.W. (Connecticut Univ., Storrs (USA). Dept. of Animal Genetics). 1986. Contract AC02-76EV03139. 26p. (COO—3139-51). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014663.

An overview of the authors research into teratogenesis of blood serum of patients on medication or rats injected with drugs is presented. In addition studies concerning the role of methionine in the developing fetus is given. 68 refs.

46738 (PNL—5764) Hazard classification method for facilities containing toxic chemicals at the Pacific Northwest Laboratory. Backman, G.E.; Denovan, J.T.; Nisick, N.P.; Piatt, J.A. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 16p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014190.

This document presents guidance to management on how to proceed in determining if the quantity of nonradioactive toxic materials in any Pacific Northwest Laboratory (PNL) or PNL-managed facility constitutes a potential threat to the public or to employees outside the facility. The "Immediately Dangerous to Life or Health" concept developed by the Department of Health, the Institute of Occupational Safety and Health, the Occupational Safety and Health Administration, and contractors who work with these organizations has been used as the measuring device to determine potential effects. The hazard classes (low, moderate and high) defined in the Department of Energy Order 5481.1A have been used to determine the seriousness of the potential effects. The management requirements related to the hazard classification have also been included.

46739 (PNL-SA—13923) Trace rare earth element analysis of IAEA hair (HH-1), animal bone (H-5) and other biological standards by radiochemical neutron activation. Lepel, E.A.; Laul, J.C. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76RL01830. 11p. (CONF-8606127—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013599.

From 7. international conference on modern trends in activation analysis; Copenhagen, Denmark (23 Jun 1986).

A radiochemical neutron activation analysis using a rare earth group separation scheme has been used to measure ultratrace levels of rare earth elements (REE) in IAEA Human Hair (HH-1), IAEA Animal Bone (H-5), NBS Bovine Liver (SRM 1577), and NBS Orchard Leaf (SRM 1571) standards. The REE concentrations in Human Hair and Animal Bone range from 10^{-8}g/g to 10^{-11}g/g and their chondritic normalized REE patterns show a negative Eu anomaly and follow as a smooth function of the REE ionic radii. The REE patterns for NBS Bovine Liver and Orchard Leaf are identical except that their concentrations are higher. The similarity among the REE patterns suggest that the REE do not appear to be fractionated during the intake of biological materials by animals or humans. 14 refs., 3 figs., 2 tabs.

46740 (UCRL—94281) Biomass production and nutrient responses of ponderosa pine to long-term elevated CO_2 concentrations. Fried, J.S.; Surano, K.A.; Daley, P.F.; Shinn, J.H.; Anderson, P. (Lawrence Livermore National Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Forestry and Resource Management). Jun 1986. Contract W-7405-ENG-48. 10p. (CONF-8606147—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014435.

From 9. North American forest biology workshop; Stillwater, OK, USA (15 Jun 1986).

Ponderosa pine saplings and seedlings were continuously exposed to elevated CO_2 concentrations of ambient, and ambient +75, +150, and +300 ppm in open-top chambers for 27 months. Saplings responded by reducing above ground biomass production. Although potassium concentration in both saplings and seedlings diminished as CO_2 concentration increased, no nutrients appeared to become limiting to growth as a result of elevated CO_2. Concentrations of Ca, Mg, and Zn in the saplings at different concentrations of CO_2 mirrored root densitites, indicating that an increase in root density at +150 ppm may account for greater nutrient concentrations observed in that tree. 17 refs., 6 figs.

46741 Microsite abundance and distribution of woody seedlings in a South Carolina cypress-tupelo swamp. Huenneke, L.F.; Sharitz, R.R. (Savannah River Ecology Lab., Aiken, SC). *American Journal of Public Health;* 76: No. 5, 328-335(May 1986). Contract AC09-76SR00819.

At least 16 types of microsites or substrates for vascular plant seedlings can be distinguished in bald cypress-water tupelo (Taxodium distichum-Nyssa aquatica) swamps. We measured the relative abundances of these microsite types, and the distribution of woody seedlings on them, in two riverine swamp forests on the Savannah River floodplain, South Carolina. Microsite abundances in a little disturbed forest differed significantly from those in a more open stand which had experienced much recent sediment deposition from upstream erosion, as well as higher water temperatures. Woody seedlings were distributed nonrandomly among microsite types (i.e., not in proportion to the abundance of a given microsite type). There were significant differences in microsite distribution patterns among growth forms (tree spp. vs. shrubs vs. vines) and among species within growth form. Many human activities may alter substrate nature and abundance in a wetland, thus indirectly altering the abundance and species composition of seedling recruitment.

46742 Enzymes from auxin-pretreated pea tissue which hydrolyze xyloglucan and a xyloglucan fragment oligosaccharide. O'Neill, R.A.; White, A.R.; York, W.S.; Darvill, A.G.; Albersheim, P. (Univ. of Georgia, Athens). *Plant Physiology;* 80: No. 4, 31(Apr 1986).

From Annual meeting of the American Society of Plant Physiologists; Baton Rouge, LA, USA (8-12 Jun 1986).

Buffer extracts were prepared from stem tissue of young etiolated pea plants harvested several days after spraying with 2,4-D. Similar extracts were prepared from tissue not pretreated with 2,4-D. Extracts were partially purified by gel filtration to remove carbohydrates. Xyloglucan polymer and a xyloglucan nonasaccharide of known structure were used as substrates. Both substrates contain glucose, xylose, galactose and fucose. The ability of the pea-stem-extracts to enzymatically hydrolyze the glycosidic linkages of these substrates was determined by chemical derivatization of the enzyme reaction products and analysis by gas chromatography-mass spectrometry. Such experiments established that the extracts contained enzymes that hydrolyzed a portion of the glycosidic linkages of each of the four sugar types present in the substrates. Extracts of auxin-pretreated tissue hydrolyzed a greater proportion of the linkages of each type of sugar in the substrates. Work is currently underway to purify and characterize the enzymes responsible for the hydrolytic activities observed.

46743 **Mercury-binding proteins from the marine mussel, Mytilus edulis.** Roesijadi, G. (Pennsylvania State Univ., University Park). *Environmental Health Perspectives;* 65: 45-48(Mar 1986). Contract AC06-76RL01830.

The marine mussel, Mytilus edulis, possesses low molecular weight, metal-binding proteins which can be induced by and, in turn, bind mercury when individuals are exposed to low, but elevated concentrations of mercury as $HgCl_2$. Induction of the proteins by exposure of mussels to copper, cadmium, or mercury is associated with enhanced tolerance to mercury toxicity. Mercury-binding proteins isolated from gills of mussels occur as two molecular weight variants of about 20-25 and 10-12 kdaltons, respectively, on Sephadex G-75. These have been designated as $HgBP_{20}$ and $HgBP_{10}$ following the nomenclature used for cadmium-binding proteins. $HgBP_{20}$ represents the primary mercury-binding species. Separation of $HgBP_{20}$ by anion-exchange high-performance liquid chromatography resulted in the resolution of six peaks, indicating a more complex situation than was evident from DEAE-cellulose separations. Although not completely purified, these also contain cysteine- and glycine-rich proteins.

46744 **Relationships between free cadmium ion activity in seawater, cadmium accumulation and subcellular distribution, and growth in polychaetes.** Jenkins, K.D.; Sanders, B.M. (California State Univ., Long Beach). *Environmental Health Perspectives;* 65: 205-210(Mar 1986).

We have examined the relationships between Cd ion activity (Cd^{2+}), in seawater, Cd accumulation and subcellular distribution and growth in the polychaete Neanthes arenaceodentata. Organisms were exposed for 3 weeks to a range of (Cd^{2+}) in a Cd-chelate buffer system. Cadmium accumulation and growth were monitored weekly for each exposure group and subcellular Cd distributions were determined at the end of the 3-week period. We found Cd associated with all of the subcellular fractions except the very low molecular weight ligands. Total Cd accumulation was greatest at day 7 and decreased over time in all but the highest (Cd^{2+}) where it remained constant. For each point in time, however, there was a linear relationship between total Cd and (CD^{2+}) in seawater. Linear relationships were also observed between (Cd^{2+}) and Cd loading in each subcellular ligand pool. Specific growth rates varied with both (Cd^{2+}) and time in a nonlinear manner.

46745 **Sister chromatid exchange induction and persistence in peripheral blood and spleen lymphocytes of mice treated with ethylnitrosourea.** Tucker, J.D.; Strout, C.L.; Christensen, M.L.; Carrano, A.V. (Lawrence Livermore National Lab., CA). *Environmental Mutagenesis;* 8: No. 3, 345-355(1986). Contract W-7405-ENG-48.

The induction and persistence of sister chromatid exchanges (SCEs) were studied in peripheral blood and spleen lymphocytes of mice given a single i.p. injection of ethylnitrosourea (ENU) of 100, 350, or 600 μMoles ENU/kg. SCE frequencies were measured on days 1, 3, 5, and 7, and at seven additional times up to 172 days post-injection. The SCE frequencies and proportion of HFCs in each dose and tissue remained elevated for up to 172 days following treatment, although the degree and statistical significance of the increase varied according to the tissue, dose, and statistical test employed. The SCE frequencies were found to oscillate during the first week. Following this, however, the return of the SCE frequencies to control levels was fit to a linear regression model with time as the only independent variable. The persistence of SCE-forming lesions was found to be dose-dependent for the spleen but not for blood. Within each dose the persistence of SCE-forming lesions was significantly greater for the blood relative to the spleen.

46746 **Tests for mutagenic effects of ammoniated glycyrrhizin, butylated hydroxytoluene, and gum arabic in roden germ cells.** Sheu, C.W.; Cain, K.T.; Rushbrook, C.J.; Jorgenson, T.A.; Generoso, W.M. (Food and Drug Administration, Washington, DC). *Environmental Mutagenesis;* 8: No. 3, 357-367(1986). Contract AC05-84OR21400.

Ammoniated glycyrrhizin, butylated hydroxytoluene, and gum Arabic are generally recognized as safe (GRAS) substances that are used primarily as additives in foods. These substances were incorporated into rodent diets and fed to male rats and mice for 10 and 8 wk, respectively. The treated male mice and rats were then tested for dominant lethal effects. The mice were also tested for induced heritable translocation. Results of the rat studies indicated a statistically significant dominant lethal effect of each of the compounds tested; however, the biological significance of this response is not known. Results of the mouse dominant lethal and heritable translocation studies, on the other hand, indicated no adverse effects of the compounds tested.

46747 **Review: putative mutagens and carcinogens in foods. VII. Genetic toxicology of the diet.** Hatch, F.T.; MacGregor, J.T.; Zeiger, E. (Lawrence Livermore National Lab., CA). *Environmental Mutagenesis;* 8: No. 3, 467-484(1986). Contract W-7405-ENG-48.

Individual reviews of approximately 30 papers presented at the Fourth International Conference on Environmental Mutagens are presented in this report. Topics covered include diet in cancer epidemiology; cooked and processed food as a source of mutagens and carcinogens; natural genotoxins in plants and beverages; mutagens within the gastrointestinal tract; and modulation of mutagenesis and carcinogenesis.

46748 **Classifying mutagens as to their specificity in causing the six possible transitions and transversions: a simple analysis using the Salmonella mutagenicity assay.** Levin, D.E.; Ames, B.N. (Univ. of California, Berkeley). *Environmental Mutagenesis;* 8: No. 1, 9-28(1986). Contract AS03-76EV70156.

The standard Salmonella tester strains used to detect base substitution mutations carry the hisG428 ochre mutation (TA102 and TA104) and the hisG46 missense mutation (TA100). These mutations can be reverted by base changes at their mutant his loci or at extragenic suppressor loci. The base changes resulting in each class of revertants of these mutations have been identified, and simple phenotypic screens have been developed to distinguish among them. These screens are the basis for a rapid and simple system for determining the base substitution specificity of mutagens using hisG428- and hisG46-containing tester strains. Diagnostic mutagens specific for each of the six possible base changes (transitions and transversions) have been identified. Using these diagnostic mutagens, two additional strains, each specifically reverted by a single base substitution mutation, have been developed to provide a minimum of two loci at which to detect each type of base change.The ability of this system to provide detailed information about mutational specificity in a variety of DNA repair backgrounds will allow further elucidation of the mechanisms of mutagenesis and DNA repair.

46749 **Interlaboratory comparison of transformation in Syrian hamster embryo cells with model and coded chemicals.** Tu, A.; Hallowell, W.; Pallotta, S.; Sivak, A.; Lubet, R.A.; Curren, R.D.; Avery, M.D.; Jones, C.; Sedita, B.A.; Huberman, E. (Arthur D. Little Inc., Cambridge, MA). *Environmental Mutagenesis;* 8: No. 1, 77-98(1986).

Three independent laboratories tested eight model and five coded chemicals in the Syrian hamster embryo clonal transformation assay system to establish the intra- and interlaboratory reproducibility of the system and to identify sources of variability. When

a common cell pool and the same lot of fetal calf serum were used, the three laboratories obtained consensus on the activity of eight model chemicals; five chemicals (benzo(a)pyrene, 7,12-dimethylbenz(a)anthracene, N-methyl-N'-nitro-N-nitrosoguanidine, nitroquinoline-N-oxide, and lead chromate) induced morphological transformation without exogenous metabolic activation and three (N-2-fluorenylacetamide, pyrene, and anthracene) produced no transformation response. Five coded chemicals (2,6-dichloro p-phenylenediamine, 4,4'-oxydianiline, cinnamyl anthranilate, dichlorvos, and reserpine), representative of environmental chemical classes, but not necessarily strong carcinogens, produced more equivocal responses in this interlaboratory study. Efforts to increase the transformation frequency or to amplify the expression of the transformed phenotype constitute some of the approaches which should be explored in order to overcome these limitations.

46750 Mt. St. Helens ash in lakes in the lower Grand Coulee, Washington State. Edmondson, W.T.; Litt, A.H. (Univ. of Washington, Seattle). *Verhandlungen - Internationale Vereinigung fuer Theoretische und Angewandte Limnologie;* **22**: 510-512(Jul 1984).

The Mt. St. Helens eruption dropped ash into two alkaline lakes in Central Washington State that had been under study for 30 years. These are Soap Lake and Lake Lenore in the Lower Grand Coulee. These lakes were first studied for interest in their specialized, limited flora and fauna and high productivity. Following dilution by fresh water from a large irrigation project, the lakes showed a profound change in community structure. Salinity was, however, finally stabilized. One species of trout - the Lahontan cutthroat trout - able to survive in alkaline, moderately saline water has been successfully introduced. A predation experiment established in 1979 was perturbed but not ruined by the ash from the Mt. St. Helens eruption, but it is still too early to see the effect of the trout on the benthos and the plankton, and to assess the trout's importance in the community.

5604 Other Environmental Pollutant Effects

46751 (DOE/ET/29078—T2) Tissue interactions with nonionizing electromagnetic fields. Final report, March 1979-February 1986. Adey, W.R.; Bawin, S.M.; Byus, C.V.; Cain, C.D.; Lin-Liu, S.; Luben, R.A.; Lyle, D.B.; Sagan, P.M.; Sheppard, A.R.; Stell, M.A. (Jerry L. Pettis Memorial Veterans Administration Medical Center, Loma Linda, CA (USA); Loma Linda Univ., CA (USA); California Univ., Riverside (USA). Div. of Biomedical Sciences). Aug 1986. Contract AI01-79ET29078. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014715.

This report provides an overview of this research program focused on basic research in nervous system responses to electric fields at 60 Hz. The emphasis in this project was to determine the fundamental mechanisms underlying some phenomena of electric field interactions in neural systems. The five studies of the initial program were tests of behavioral responses in the rat based upon the hypothesis that electric field detection might follow psychophysical rules known from prior research with light, sound and other stimuli; tests of electrophysiological responses to "normal" forms of stimulation in rat brain tissue exposed in vitro to electric fields, based on the hypothesis that the excitability of brain tissue might be affected by fields in the extracellular environment; tests of electrophysiological responses of spontaneously active pacemaker neurons of the Aplysia abdominal ganglion, based on the hypothesis that electric field interactions at the cell membrane might affect the balance among the several membrane-related processes that govern pacemaker activity; studies of mechanisms of low frequency electromagnetic field interactions with bone cells in the context of field therapy of ununited fractures; and manipulation of cell surface receptor proteins in studies of their mobility during EM field exposure.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 45651, 46224, 46229, 46244, 46595, 46670

46752 (DOE/ER/13124—2) Structural evolution of the Central Brooks Range, Alaska. Final report, September 1, 1983-November 30, 1985. Ave'Lallemant, H.G. (Rice Univ., Houston, TX (USA). Dept. of Geology and Geophysics). 1985. Contract AS05-83ER13124. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013986.

This report summarizes work completed in mapping in detail the following areas: (1) Doonerak Window; (2) Hammond River Klippe; and (3) Schist Belt. (ACR)

46753 (DOE/ER/60376—12b) Physical oceanographic processes affecting larval transport around and through North Carolina inlets. Pietrafesa, L.J.; Janowitz, G.S. (North Carolina State Univ., Raleigh (USA). Dept. of Marine, Earth and Atmospheric Sciences). 1985. Contract FG09-85ER60376. 46p. (CONF-8508188—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013057.

From Larval fish and shellfish transport through coastal inlets; Ocean Springs, MS, USA (19 Aug 1985).

Atlantic Spot, Flounder, Croaker and Menhaden all spawn in shelf waters of North Carolina during late fall to early winter. The juveniles use estuaries such as Pamlico Sound and the Cape Fear River as nurseries during their first winter and spring. Previous studies of recruitment into the estuaries through barrier island inlets or estarine mouths assume that the pre and post metamorphosed larvae enter the estuaries at the bottom of the water column and move upstream thereafter. The mechanisms were presumed tidal. The Pamlico Sound has several inlets, Oregon, Hatteras and ocracroke, through which larvae can enter not only during flood stages of the tide but also in the presence of favorable oceanic to estuary sea level pressure gradients. The Cape Fear River has a strong semi-diurnal tidal flow both flood and ebb and also responds vigorously to one-sided divergences and convergences at its mouth. Flow, looking out of the mouth, is in at the left and out on the right. The conclusions are that, in addition to flooding tides, nonlocal forcing at the estuary mouths can effect transport of larval fish through the estuary mouths, throughout the entire water column.

46754 (INIS-mf—10174, pp X/43) **Cosmogenic sodium-22 and dating of natural fresh waters.** Fleishman, D.G.; Gorin, V.D.; Gritchenko, Z.G. (AN SSSR, Leningrad. Inst. Ehvolyutsionnoj Fiziologii i Biokhimii; AN SSSR, Moscow. Inst. Geokhimii i Analiticheskoj Khimii; Radievyj Inst., Leningrad, USSR). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46755 (INIS-mf—10174, pp X/45) **Early Slavic settlements and navigation at the mouth of Odra river.** Awsiuk, R.; Goslar, T.; Pazdur, A.; Pazdur, M.F.; Filipowiak, W. (Politechnika Slaska, Gliwice, Poland. Inst. Fizyki; National Museum, Sczecin, Poland). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46756 (INIS-mf—10174, pp X/46) **Radiocarbon dating and late glacial blown sand movements in NE Hungary.** Csongor, E.; Borsy, Z. (Magyar Tudomanyos Akademia, Debrecen. Atommag Kutato Intezete; Kossuth Lajos Tudomanyegyetem, Debrecen, Hungary). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46757 (INIS-mf—10174, pp XI/60) **Radiocarbon dating in palaeomorphological and sedimentological research, the example of the Mark river basin.** Van Strydonck, M.; Dauchot-Dehon, M.; Huybrechts, W. (Koninklijk Instituut voor het Kunstpatrimonium, Brussels, Belgium; Vrije Univ., Brussels, Belgium). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46758 (INIS-mf—10174, pp XVI/98) **$^{230}Th/^{234}U$ dating of carbonate cave deposits in Poland.** Dulinski, M.; Rozanski, K. (Institute of Physics and Nuclear Techniques, Krakow, Poland). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46759 (ORNL/TM—9678) **Application of the finite element groundwater model FEWA to three regional aquifers.** Wong, K.F.V.; Yeh, G.T. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE86014408.

This report documents the calibration with field data and predictive application of a finite element model of water through aquifers (FEWA). FEWA was described in a report written by G.T. Yeh and D.D. Huff in 1983. The model was first compared with the United States Geological Survey (USGS) two-dimensional model and found superior in treating anisotropic media when the coordinates cannot be made to coincide with the principal directions of hydraulic conductivities. In addition, there was no necessity to define nodal points outside the region, as required by the USGS model. FEWA was next calibrated with measured potentiometric surfaces from the Love Canal area in New York and the Conesville area in Ohio. There were satisfactory matches between computed results and available field data. The calibration and predictive runs of FEWA were then accomplished with the Hialeah-Preston well field data over the Biscayne aquifer in south Florida. The calibration run yielded two values of hydraulic conductivity in the area, and the predictive run gave results that matched well with available data. 18 refs., 28 figs.

5802 Geophysics

REFER ALSO TO CITATION(S) 46752

46760 **Mantle circulation and the lateral migration of subducted slabs.** Garfunkel, Z.; Anderson, C.A.; Schubert, G. (Department of Geology, The Hebrew University of Jerusalem, Israel). *Journal of Geophysical Research;* **91**: No. B7, 7205-7224(10 Jun 1986).

The irregular motions of plates and the irregular distribution of plate consumption and generation require that subduction zones and descending lithospheric slabs migrate laterally. Absolute plate motions indicate that slab migration is generally retrograde; that is, it is opposite to the direction of motion of the plates to which the slabs are attached, at rates of 10—25 mm yr^{-1}. As a result, the downward motions of slabs are generally steeper than their dips, probably because of their negative buoyancy relative to the surrounding mantle. An important consequence of lateral slab migration is the displacement of material away from one side of the slab and inward flow of an equal volume toward the other side. This generates a mass flux in the mantle that is comparable in magnitude with the flux involved in the overturn of the oceanic lithosphere. The flow induced by slab migration is, therefore, an important part of the large-scale mantle circulation associated with plate motions. Two-dimensional numerical models with retrograde slab migration explicitly prescribed as a boundary condition show that migrating slabs, in contrast with nonmigrating ones, are at an angle to streamlines in the surrounding mantle.

46761 **Attenuation and scattering of broadband P-italic and S-italic waves across North America.** Taylor, S.R.; Bonner, B.P.; Zandt, G. (Earth Sciences Division, Lawrence Livermore National Laboratory, University of California, Livermore). *Journal of Geophysical Research;* **91**: No. B7, 7309-7325(10 Jun 1986).

Differential attenuation (δt-italic*) measurements of teleseismic P-italic and S-italic waves are made in the frequency range 0.05—5.0 Hz across North America using broadband seismic data from the Department of Energy's Regional Seismic Test Network and Lawrence Livermore National Laboratory's Basin and Range network. Data from four events have been analyzed by first assuming frequency independent Q-italic. The observed regional variations for (δt-italic*) are consistent with previous studies and show greater attenuation for stations in the Basin and Range relative to those in shield regions of North America.

5803 Mineralogy, Petrology, And Rock Mechanics

46762 (UCRL—53630) **Hydrothermal interaction of crushed Topopah Spring tuff and J-13 water at 90, 150, and 250°C using Dickson-type, gold-bag rocking autoclaves.** Knauss, K.G.; Beiriger, W.J.; Peifer, D.W. (Lawrence Livermore National Lab., CA (USA)). May 1985. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014752.

As part of the Package Environment subtask of the Waste Package task within the Nevada Nuclear Waste Storage Investigations (NNWSI) Project, experiments were conducted to study the hydrothermal interaction of rock and water representative of a potential high-level waste repository in tuff. These experiments used crushed Topopah Spring tuff from both drillcore and outcrop samples. The data, when considered in conjunction with results from analogous experiments using solid wafers of tuff, define near-field repository conditions and can be used to assess the ability to use "accelerated" tests based on the surface area/volume (SA/V) parameter and temperature; allow the measurement of chemical changes due to reaction in phases present in the tuff before reaction; and permit the identification and chemical analysis of secondary phases resulting from hydrothermal reactions. Some of the results presented in this report have been used to demonstrate the usefulness of geochemical modeling in a repository environment using the EQ3/6 thermodynamic/kinetic geochemical modeling code. The tuff was reacted with a natural ground water in Dickson-type gold-bag rocking autoclaves that were periodically sampled under in situ conditions. Five short-term (<90-day) experiments using crushed tuff were run covering the range 90 to 250°C and 50 to 100 bars. This report will focus on the results of experiments with crushed tuff, while a companion report will cover results of analogous short-term experiments run with solid waters of tuff.

46763 **Use of digital image analysis to estimate fluid permeability of porous materials: Application of two-point correlation functions.** Berryman, J.G.; Blair, S.C. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808 L-156, Livermore, California 94550). *Journal of Applied Physics;* **60**: No. 6, 1930-1938(15 Sep 1986).

Scanning electron microscope images of cross sections of several porous specimens have been digitized and analyzed using image processing techniques. The porosity and specific surface area may be estimated directly from measured two-point spatial correlation functions. The measured values of porosity and image specific surface were combined with known values of electrical formation factors to estimate fluid permeability using one version of the Kozeny-Carman empirical relation. For glass bead samples with measured permeability values in the range of a few darcies, our estimates agree well (+- 10—20%) with the measurements. For samples of Ironton-Galesville sandstone with a permeability in the range of hundreds of millidarcies, our best results agree with the laboratory measurements again within about 20%. For Berea sandstone with still lower permeability (tens of millidarcies), our predictions from the images agree within 10—30%. Best results for the sandstones were obtained by using the porosities obtained at magnifications of about 100 x (since less resolution and better statistics are

required) and the image specific surface obtained at magnifications of about 500 x (since greater resolution is required).

46764 **Phase transitions, Grueneisen parameter, and elasticity for shocked iron between 77 GPa and 400 GPa.** Brown, J.M.; McQueen, R.G. (Geophysics Program, University of Washington, Seattle). *Journal of Geophysical Research;* 91: No. B7, 7485-7494(10 Jun 1986).

Sound velocities determined in iron, shock compressed to pressures between 77 GPa and 400 GPa, indicate that two phase transitions exist on the Hugoniot. A discontinuity in sound velocities at 200 +- 2 GPa may mark the transition of epsilon-c iron to γ iron. A second discontinuity at 243 +- 2 GPa is believed to indicate the onset of melting. The calculated temperature at melting lies between 5000 K and 5700 K. When extrapolated from the Hugoniot melting point, the Lindermann criterion yields an estimate of 5800 +- 500 K for the melting of pure iron at the inner core boundary pressure of 330 GPa. The product of density times the thermodynamic Grueneisen parameter in liquid iron, calculated from the present data, is 19.6 +- 0.8 Mg m^{-3}. A temperature profile ranging from 3800 K at the core-mantle boundary to 5000 K at the earth's center is calculated using the present data. Sound velocities for epsilon-c iron provide a better match to seismic velocities for the earth's inner core than do those of γ iron. A comparison between liquid iron velocities and the velocity profile through the outer core provides further evidence for alloying of iron with "lighter elements" in the core.

5804 Geochemistry

REFER ALSO TO CITATION(S) 46233

46765 **(BMI/ONWI—512) Preliminary thermomechanical analyses of a conceptual nuclear waste repository at four salt sites.** Wagner, R.A.; Loken, M.C.; Tammemagi, H.Y. (RE/SPEC, Inc., Albuquerque, NM (USA)). Jul 1986. Contract AC02-83CH10140. 231p. NTIS, PC A11/MF A01; GPO Dep. File Number DE86014477.

This report describes preliminary thermal and thermomechanical numerical analyses of a potential nuclear waste repository at four salt sites: Paradox Basin, Utah; Permian Basin, Texas; Richton Dome, Mississippi; and Vacherie Dome, Louisiana. The analysis is subdivided according to three distinct geometric regions: canister, disposal room, and repository. An evaluation of the thermal and thermomechanical responses is performed to assess the suitability of each site to host a nuclear waste repository, under a given set of conceptual design assumptions that have not been optimized. In order to compare the thermal and thermomechanical responses of the rock, the same base case repository conditions were assumed to be used as a ruler to measure salt response relative to each site. Absolute values have not been determined; this report presents a relative comparison of differences that exist between sites due to depth and salt creep characteristics. This report represents the first attempt at calculating relative differences in rock responses and in no way represents values which should be used in a specific design. 44 refs., 21 figs., 11 tabs.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 46491, 46567, 46602, 46619, 46947, 46947, 46971, 46987

46766 **(AD-A—167374/8/XAB) North/south asymmetry in solar activity and its effects on the high-energy cosmic-ray diurnal variation.** Shea, M.A.; Smart, D.F.; Swinson, D.B.; Humble, J.E. (New Mexico Univ., Albuquerque (USA). Dept. of Physics and Astronomy). 1986. 7p. NTIS, PC A02/MF A01.

Using a data base extending from 1955 through 1980 we find that the northern hemisphere of the sun was decidedly more active than the southern hemisphere for the period 1959 through 1970. From 1971 through 1980 there was no systematic asymmetry. Extending the time period through 1984, but using a different data base, we find an apparent change around October 1982, after which there are decidedly more flares occurring in the southern hemisphere of the sun than in the northern hemisphere. Examination of the diurnal variation amplitude present in the extremely high energy (approximately 100 GeV) cosmic radiation measurements indicates a consistent north/south asymmetry until about 1971 which we suggest is the result of the asymmetric solar activity.

46767 **(AD-A—167692/3/XAB) Amplitude distribution of cosmic ray events in extrinsic IR detectors. Technical report.** Aukerman, L. (Aerospace Corp., El Segundo, CA (USA). Electronics Research Lab.). 15 Mar 1986. 23p. (TR—0086(6427-01)-1). NTIS, PC A02/MF A01.

A method of calculating the amplitude distribution of cosmic-ray events in IR detectors utilizing known range-energy relationships for the various cosmic particles (mostly protons and helium nuclei) and published cosmic-ray energy spectra is described. Good agreement is obtained between the calculated amplitude distribution and the spurious events observed in an extrinsic detector during a flight test.

46768 **(AD-A—167923/2/XAB) Periodic amplitude variations in Jovian continuum radiation. Progress report for period ending February 1986.** Kurth, W.S.; Gurnett, D.A.; Scarf, F.L. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 2 Apr 1986. 31p. NTIS, PC A03/MF A01.

An analysis of periodic variations in the amplitude of continuum radiation trapped in the Jovian magnetosphere shows structure with periods near both five and ten hours. Contrary to a plausible initial idea, the continuum amplitudes are not organized by position of the observer relative to the dense plasma sheet. Instead, there seem to be preferred orientations of system III longitude with respect to the direction to the sun which account for the peaks. This implies a clock-like modulation of the continuum radiation intensity as opposed to a searchlight effect. The importance of the dipole longitude-solar wind alignment to the amplitude of the continuum radiation implies the source region of the radiation is near the magnetopause and may tie the generation of the radio waves to the clock like modulation of energetic electron fluxes from Jupiter.

46769 **(AD-A—167924/0/XAB) Plasma-wave observations at Uranus from Voyager 2. Progress report for period ending February 1986.** Gurnett, D.A.; Kurth, W.S.; Scarf, F.L.; Poynter, R.L. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 26 Mar 1986. 21p. NTIS, PC A02/MF A01.

Radio emissions from Uranus were detected by the Voyager 2 plasma-wave instrument about 5 days before closest approach at frequencies of 31.1 and 56.2 khz. The bow shock was identified by an abrupt broadband burst of electrostatic turbulence about 10 hours before closest approach at a radial distance of 23.5 ru. Once inside of the magnetosphere, strong whistler mode hiss and chorus emissions were observed at radial distances less than about 8 R/sub u/, in the same region where the energetic-particle instruments detected intense fluxes of energetic electrons. A variety of other plasma waves, such as (f sub c) electron-cyclotron waves, were also observed in this same region. At the ring plane crossing, the plasma wave instrument detected a large number of impulsive events that are interpreted as impacts of micron-sized dust particles on the spacecraft. The maximum impact rate was about 20 to 30 impacts/sec, and the north-south thickness of the impact region was about 4000 km. This paper presents an overview of the principal results from the plasma-wave instrument, starting with the first detection of radio emissions from Uranus, and ending a few days after closest approach.

46770 **(DOE/ER/10719—T3) Research in nuclear astrophysics: stellar collapse and supernovae. Progress report.** Lattimer, J.M.; Yahil, A. (State Univ. of New York, Stony Brook (USA)). Aug 1986. Contract AC02-80ER10719. 14p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014252.

This proposal describes the nuclear astrophysics research program in the Earth and Space Sciences Department at Stony

Brook. The central themes in the many projects that comprise this program are supernovae, neutron star formation, and the equation of state of hot, dense matter. There is a close coupling between the physics of nuclear matter on the one hand, and supernova and neutron stars on the other. (The collapse of massive stars is thought to lead to Type II supernovae and the creation of neutron stars. A summary of the historical background and of recent developments in the theory of Type II supernovae, complete with references, is contained in the Appendix.) The properties of nuclear matter, together with those of the weak interactions, determine the outcome of models of Type II supernovae; thus, optical observations of supernovae and neutrons stars may set some limits on the nuclear equation of state. In the future, the detection of neutrinos, which are the only available observables of the internal supernova mechanism, will impose tighter constraints on nuclear matter properties.

46771 **(DOE/ER/40048—171-L6) Search for the beta-decay of ^{180}Lu to ^{180}Hf/sup m/.** Kellogg, S.E.; Norman, E.B. (Washington Univ., Seattle (USA). Nuclear Physics Lab.; Lawrence Berkeley Lab., CA (USA)). 1986. Contract AC03-76SF00098;AC06-81ER40048. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014378.

The t/sub 1/2/ = 5.7 minute ^{180}Lu isotope was produced in the ^{180}Hf(n,p) reaction and its subsequent β decay back to ^{180}Hf was studied with a Ge(Li) spectrometer. A radiochemical technique was used to measure the fractional population of the I/sup π/,K=(8$^-$,8) isomer in ^{180}Hf to be f/sub m/ = 0.005 +- 0.018%. The limit of f/sub m/ is shown to be too small to account for the nucleosynthesis of ^{180}Ta/sup m/ in the r-process. The possible existence of a high-spin isomer in ^{180}Lu and its astrophysical consequences are discussed. 23 refs., 3 figs., 3 tabs.

46772 (INIS-mf—10174, pp IX/39) **Long-term cosmic ray variations - present status.** Emrich, P.; Masarik, J.; Povinec, P. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46773 (INIS-mf—10174, pp X/40) **Long-lived cosmogenic isotopes and some astrophysical phenomena.** Kocharov, G.E.; Blinov, A.V.; Konstantinov, A.N.; Levchenko, V.A. (AN SSSR, Leningrad. Inst. Vysokomolekulyarnykh Soedinenij). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46774 (INIS-mf—10174, pp X/41) **Time-variations of nuclear reactions rate in the earth's atmosphere and cosmic ray intensity during last 400 years obtained using radiocarbon data.** Kocharov, G.E.; Metskhvarishvili, R.Ya. (AN SSSR, Leningrad. Inst. Vysokomolekulyarnykh Soedinenij; Tbilisskij Gosudarstvennyj Univ., USSR). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46775 **(INIS-mf—10406) Reflection and transmission of polarized light by planetary atmospheres.** Rooij, W.A. de. (Vrije Univ., Amsterdam (Netherlands)). 12 Sep 1985. 262p. NTIS (US Sales Only), PC A12/MF A01. File Number DE86703135.

In this thesis the reflection and transmission of sunlight by planetary atmospheres is studied, taking full account of the polarization of light. The atmospheres are treated as being locally plane-parallel, and are assumed to consist of a number of homogeneous layers, the lowest one being either a ground surface or a semi-infinite homogeneous layer. Includes Dutch summary; 220 refs.; 33 figs.; 33 tabs.

46776 **(LA-UR—86-2350) Smooth particle hydrodynamics: theory and application to the origin of the moon.** Benz, W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 9p. (CONF-8606175—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013854.

From Workshop on the use of supercomputers in stellar dynamics; Princeton, NJ, USA (2 Jun 1986).

The origin of the moon is modeled by the so-called smooth particle hydrodynamics (SPH) method (Lucy, 1977, Monaghan 1985) which substitutes to the fluid a finite set of extended particles, the hydrodynamics equations reduce to the equation of motion of individual particles. These equations of motion differ only from the standard gravitational N-body problem insofar that pressure gradients and viscosity terms have to be added to the gradient of the potential to derive the forces between the particles. The numerical tools developed for "classical" N-body problems can therefore be readily applied to solve 3 dimensional hydroynamical problems. 12 refs., 1 fig.

46777 **(N—86-25307) International Ultraviolet Explorer atlas of O-type spectra from 1200 to 1900 angstrom.** Walborn, N.R.; Nichols-Bohlin, J.; Panek, R.J. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Dec 1985. 153p. (NASA-RP—1155). NTIS, PC A08/MF A01.

The IUE archives provide an unprecedented sample of uniform, high-quality ultraviolet stellar spectra. In particular, they contain high-resolution SWP data for nearly 200 different O stars. We have undertaken a survey of the 1200-1900 A region in about 120 of them having homogeneous optical spectral classifications to investigate systematically the behavior of the ultraviolet features, incuding the prominent stellar wind profiles and the degree to which they correlate with the optical types. The standard extracted spectrograms have been rebinned to a constant wavelength resolution of 0.25A and uniformly normalized (not dereddened) at the GSFC RDAF. They are then plotted at 10A/cm, with reseau, photometric quality and echelle order junction flags available. This atlas contains such plots for about 100 stars, arranged in spectral-type, luminosity and peculiar object sequences. The results show a high degree of correlation between the ultraviolet features, both photospheric and stellar-wind, and the optical classifications for the majority of the O-type stars.

46778 **(N—86-25316) Possible importance of synchrotron/inverse Compton losses to explain fast mm-wave and hard x-ray emission of a solar event.** Correia, E.; Kaufmann, P.; Costa, J.E.R.; Vaz, A.M.Z.; Dennis, B.R. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Feb 1986. 11p. (NASA-TM—88659; INPE—3809-PRE/895; CONF-8509317—1). NTIS, PC A02/MF A01.

From SMM topical workshop on rapid fluctuations in solar flares; Lanham, MD, USA (30 Sep 1985).

The solar burst of 21 May 1984 presented a number of unique features. The time profile consisted of seven major structures (seconds), with a turnover frequency or approx. 90 GHz, well correlated in time to hard x-ray emission. Each structure consisted of multiple fast pulses (.1 seconds), which were analyzed in detail. A proportionality between the repetition rate of the pulses and the burst fluxes at 90 GHz and or approx. 100 keV hard x-rays, and an inverse proportionality between repetition rates and hard x-ray power law indices have been found. A synchrotron/inverse Compton model has been applied to explain the emission of the fast burst structures, which appear to be possible for the first three or four structures.

46779 **(N—86-26263) Search for metal lines in the spectra of DA white dwarfs. Semiannual Report, 1 October 1984-31 March 1985.** Wegner, G.A. (Dartmouth Coll., Hanover, NH (USA)). Jun 1986. 22p. (NASA-CR—176825). NTIS, PC A02/MF A01.

A theoretical analysis was carried out in order to interpret the ultraviolet spectra of DB white dwarfs obtained earlier with the International Ultraviolet Explorer (IUE) satellite. Here the results of the IUE ultraviolet spectroscopy combined with visual data and

model atmospheres of DB white dwarfs are reported. In particular, a search for spectra lines due to the element carbon using the ultraviolet was made. In no case is there a positive detection of carbon and from these data, and upper limits for carbon by number relative to helium are derived in the range of C: He 10 to the minus 5 power to 10 to the minus 7 power for the 16 DB stars with ultraviolet spectra in the temperature range 11400 K T/sub EFF/ less than 2300 K. The low carbon abundances found in the atmospheres of the DB stars agree well with the hypothesis that the atmospheric carbon observed in the cooler DQ members of the helium-rich white dwarf sequence is produced by a convective dredging mechanism.

46780 (N—86-26266) Highly ionized atoms in cooling gas. Edgar, R.J.; Chevalier, R.A. (Virginia Univ., Charlottesville (USA)). 1986. 16p. (NASA-CR—176819). NTIS, PC A02/MF A01.

The ionization of low density gas cooling from a high temperature was calculated. The evolution during the cooling is assumed to be isochoric, isobaric, or a combination of these cases. The calculations are used to predict the column densities and ultraviolet line luminosities of highly ionized atoms in cooling gas. In a model for cooling of a hot galactic corona, it is shown that the observed value of N(N V) can be produced in the cooling gas, while the predicted value of N(Si IV) falls short of the observed value by a factor of about 5. The same model predicts fluxes of ultraviolet emission lines that are a factor of 10 lower than the claimed detections of Feldman, Brune, and Henry. Predictions are made for ultraviolet lines in cooling flows in early-type galaxies and clusters of galaxies. It is shown that the column densities of interest vary over a fairly narrow range, while the emission line luminosities are simply proportional to the mass inflow rate.

46781 (N—86-26270) Investigation of the energy balance of solar active regions using the ACRIM irradiance data. Final Report. Petro, L.D. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). Feb 1986. 82p. (NASA-CR—176788). NTIS, PC A05/MF A01.

The detection of a significant correlation between the solar irradiance, corrected for flux deficit due to sunspots, and both the 205 nm flux and a photometric facular index were examined. A detailed analysis supports facular emission as the more likely source of correlation with the corrected radiance, rather then the error in sunspot correction. A computer program which simulates two dimensional convection in a compressible, stratified medium was investigated. Subroutines to calculate ionization and other thermodynamic variables were also completed.

46782 (PB—86-196086/XAB) Solar-Geophysical Data Number 499, March 1986. Part 1 (prompt reports). Data for February 1986, January 1986, and late data. Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Mar 1986. 175p. (SGD—499-PT-1). NTIS, PC A08/MF A01.

Contents include: Detailed index for 1985-86; Data for February 1986– (IUWDS alert periods (Advance and worldwide), Solar-activity indices, Solar flares, Solar radio emission, Vostok inferred interplanetary magnetic field polarity, Stanford mean solar magnetic field); Data for January 1986–(Solar-active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio-propagation indices); Late data-(Solar-active regions, Solar radio-spectral observations, Culgoora, Cosmic-ray measurements by neutron monitor, Calcium plage data).

46783 (PB—86-196094/XAB) Solar-Geophysical Data Number 499, March 1986. Part 2 (comprehensive reports). Data for September 1985, and miscellanea. Coffey, H.E. (National Geophysical Data Center, Boulder, CO (USA)). Mar 1986. 36p. (SGD—499-PT-2). NTIS, PC A03/MF A01.

Contents: Detailed index for 1985-86; Data for September 1985– (Solar flares, Solar radio bursts at fixed frequencies; Solar x-ray radiation from GOES satellite; Mass ejections from the sun; Active prominences and filaments); (Meudon carte synoptique 7 July - 26 September 1985, Solar irradiance).

46784 (PB—86-196102/XAB) Solar-Geophysical Data Number 499, March 1986. Supplement. (National Geophysical Data Center, Boulder, CO (USA)). Mar 1986. 87p. (SGD—499-SUPPL). NTIS, PC A05/MF A01.

The supplement contains the description and explanation of the data in the monthly publication Solar-Geophysical Data, compiled by the National Geophysical Data Center (NGDC) in Boulder, CO USA. Solar-Geophysical Data is intended to keep research workers informed on a timely schedule of the major events of solar activity and the associated interplanetary, ionospheric, radio propagation, and other geophysical effects.

46785 (RRK—85-12) Geodesic bi-scalars in some isotropic universes. Nariai, Hidekazu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Apr 1985. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703136.

A general formula for the geodesic bi-scalars in the Robertson-Walker universes with flat 3-space is derived, together with that for the bi-scalar Green's function corresponding to the 4-dimensional commutation function for a quantized scalar field. In terms of that formula, several explicit expressions for the geodesic bi-scalar are obtained.

46786 Microwave-background anisotropy and decaying-cold-particle scenarios. Kolb, E.W.; Olive, K.A.; Vittorio, N. (Theoretical Astrophysics Group, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* **34**: No. 4, 940-943(15 Aug 1986). Contract AC02-83ER40105.

Decaying-particle scenarios for galaxy formation are subject to constraints from limits on the anisotropy of the microwave-background radiation. In this paper we obtain limits on the properties of decaying cold dark matter.

46787 Equivalence of active and passive gravitational mass using the moon. Bartlett, D.F.; Van Buren, D. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review Letters;* **57**: No. 1, 21-24(7 Jul 1986).

A limit is established for the violation of the equality of passive and active gravitational mass. Our test is based on an asymmetry in the composition of the moon. We hypothesize that the 2-km offset between the moon's center of figure and center of mass indicates an asymmetry in the distribution of Fe and Al. Unless the Fe on one side and the Al on the other attract each other with the same force, the moon will not be in the orbit predicted by classical mechanics. Using the results from laser ranging and a model for the moon's interior we find that the ratios of active to passive mass for Fe and Al are the same to a precision of 4 x 10/sup -12/.

46788 Statistics of peaks of Gaussian random fields. Bardeen, J.M.; Bond, J.R.; Kaiser, N.; Szalay, A.S. (Washington Univ., Seattle; Stanford Univ., CA; California Univ., Berkeley; Cambridge Univ., England; Fermi National Accelerator Lab., Batavia, IL). *Astrophysical Journal;* **304**: 15-61(May 1986).

A set of new mathematical results on the theory of Gaussian random fields is presented, and the application of such calculations in cosmology to treat questions of structure formation from small-amplitude initial density fluctuations is addressed. The point process equation is discussed, giving the general formula for the average number density of peaks. The problem of the proper conditional probability constraints appropriate to maxima are examined using a one-dimensional illustration. The average density of maxima of a general three-dimensional Gaussian field is calculated as a function of heights of the maxima, and the average density of upcrossing points on density contour surfaces is computed. The number density of peaks subject to the constraint that the large-scale density field be fixed is determined and used to discuss the segregation of high peaks from the underlying mass distribution. The machinery to calculate n-point peak-peak correlation functions is determined, as are the shapes of the profiles about maxima. 67 references.

46789 CSSP implementation plan for space plasma physics programs. Baker, D.N.; Williams, D.J. (Los Alamos National Lab., NM; Johns Hopkins Univ., Laurel, MD). *EOS, Transactions, American Geophysical Union;* **66**: 1217(Dec 1985).

The Committee on Solar and Space Physics (CSSP) has provided NASA with guidance in the areas of solar, heliospheric, magnetospheric, and upper atmospheric research. The budgetary sitation confronted by NASA has called for a prioritized plane for the implementation of solar and space plasma physics programs. CSSP has developed the following recommendations: (1) continue implementation of both the Upper Atmosphere Research Satellite and Solar Optical Telescope programs; (2) initiate the International Solar Terrestrial Physics program; (3) plan for later major free-flying missions and carry out the technology development they require; (4) launch an average of one solar and space physics Explorer per yr beginning in 1990; (5) enhance current Shuttle/Spacelab programs; (6) develop facility-class instrumentation; (7) augment the solar terrestrial theory program by FY 1990; (8) support a compute modeling program; (9) strengthen the research and analysis program; and (10) maintain a stable suborbital program for flexible science objectives in upper atmosphere and space plasma physics.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 46774, 46782, 46784

46790 (N—86-25070) Morphological study of waves in the thermosphere using DE-2 observations. Final Technical Report. Gross, S.H.; Kuo, S.P.; Shmoys, J. (Polytechnic Inst. of New York, Farmingdale (USA)). May 1986. 57p. (NASA-CR—176775; POLY-MRI—1451-86). NTIS, PC A04/MF A01.

Theoretical model and data analysis of DE-2 observations for determining the correlation between the neutral wave activity and plasma irregularities have been presented. The relationships between the observed structure of the sources, precipitation and joule heating, and the fluctuations in neutral and plasma parameters are obtained by analyzing two measurements of neutral atmospheric wave activity and plasma irregularities by DE-2 during perigee passes at an altitude on the order of 300 to 350 km over the polar cap. A theoretical model based on thermal nonlinearity (joule heating) to give mode-mode coupling is developed to explore the role of neutral disturbance (winds and gravity waves) on the generation of plasma irregularities.

46791 Comment on "Increase of ion kinetic temperature across a collisionless shock: I. A new concept by L. C. Lee et al." and "Ion acceleration in quasiperpendicular magnetosonic shock waves with subcritical mach number by Y. Ohsawa and J. Sakai". Winske, D.; Gosling, J.T.; Thomsen, M.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Geophysical Research Letters;* **13**: No. 6, 561-562(Jun 1986).

The question of ion heating at subcritical collisionless shocks is reviewed in light of newly proposed mechanisms.

46792 Electrical changes of the polar ionosphere during magnetospheric substorms. Ahn, B.H.; Kamide, Y.; Akasofu, S.H. (Department of Earth Science, Teachers College, Kyungpook National University, Taegu, Korea). *Journal of Geophysical Research;* **91**: No. A5, 5737-5754(1 May 1986).

Changes of the distribution of the potential, electric fields, ionospheric currents, field-aligned currents, the Joule heat production rate, the particle energy injection rate and the total energy dissipation rate are examined in detail by comparing them at a presubstorm epoch and the maximum epoch for several substorms on March 17, 18, and 19, 1978. The data sets are obtained on the basis of the magnetic records from the six International Magnetospheric Study meridian chains of observatories by using the computer code developed by Kamide e-italict-italic a-italicl-italic. (1981) and the conductivity model developed by Ahn et al. (1983b). A number of global features that are found to be common to most of the substorms examined in this study include the following: (1) The positive potential cell in the morning sector extends into the evening sector during substorms. (2) When it is intensified, the westward electrojet on the nightside tends to flow equatorward of the positive potential ridge. (3) The so-called "Harang discontinuity" may be identified as the ridge of the negative potential cell. (4) The distribution of field- aligned currents determined by our method is more complicated than the statistical pattern obtained by polar orbiting satellites. (5) The basic ionospheric current pattern is fundamentally the same during a fairly quiet period, a slightly disturbed period and a substorm period. (6) The highest Joule heat production occurs along the westward extension of the westward electrojet, while the particle energy injection rate is high along the westward electrojet in the morning sector.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 46248, 46821, 46838, 46893

46793 (AERE-R—11796) Controlled removal by ion beam etching of surface contaminant layers on transmission electron microscope specimens. James, A.W. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Physics and Metallurgy Div.). Oct 1985. 12p. H.M. Stationery Office, London, price Pound 4.00.

The basic principles of transmission electron microscope specimen preparation by ion beam thinning are described. The rate of material removal from stainless steel specimens has been assessed and this information has been used to demonstrate the controlled thinning of a TEM specimen. Three examples where ion beam wiping can be used to remove contaminated surface layers of TEM specimens are given: (i) chlorine-enriched surface regions on stainless steel; (ii) Cu-S rich films on ferritic steels; (iii) oxide films on sintered aluminium. These examples make it clear that ion beam wiping is an essential step in the preparation of some TEM specimens where accurate chemical analysis is required.

46794 (BNL—38486) Oxygen K-edge absorption spectra of small molecules in the gas phase. Yang, B.X.; Kirz, J.; Sham, T.K. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-860753—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014178.

From International conference on EXAFS and near edge structure; Saumur, France (7 Jul 1986).

The absorption spectra of O_2, CO, CO_2 and OCS have been recorded in a transmission mode in the energy region from 500 to 950 eV. Recent observation of EXAFS in these molecules is confirmed in this study. 7 refs., 3 figs.

46795 (CONF-8606157—2) Mayer-Fermi theory and the long sequences in the periodic table. Griffin, D.C.; Cowan, R.D.; Pindzola, M.S. (Rollins Coll., Winter Park, FL (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA). Physics Div.; Los Alamos National Lab., NM (USA); Auburn Univ., AL (USA). Dept. of Physics). 1986. Contract W-7405-ENG-36;AC05-84OR21400;FG05-86ER53217. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014232.

From NATO advanced study conference; Les Houche, France (16 Jun 1986).

Changes in the radial wave functions for d electrons which occur preceding the onset of the transition series of elements and for f electrons preceding the onset of the lanthanide and actinide series are examined. The sensitivity of the radial wave functions to variations in the effective potential is discussed, and the large variation in the radial wave functions between the LS terms of certain types of excited configurations in these regions of the periodic system is analyzed. Several examples of electron-impact ionization are explained by analyzing the effective potentials for the excited electrons in the intermediate autoionizing states. 46 refs., 18 figs. (WRF)

46796 **(CONF-8606166—1) Detection of single atoms by resonance ionization spectroscopy.** Hurst, G.S. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 1986. Contract AC05-84OR21400. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86011974.

From Meeting of the Fellows of the Royal Society; London, UK (27 Jun 1986).

Rutherford's idea for counting individual atoms can, in principle, be implemented for nearly any type of atom, whether stable or radioactive, by using methods of resonance ionization. With the RIS technique, a laser is tuned to a wavelength which will promote a valence electron in a Z-selected atom to an excited level. Additional resonance or nonresonance photoabsorption steps are used to achieve nearly 100% ionization efficiencies. Hence, the RIS process can be saturated for the Z-selected atoms; and since detectors are available for counting either single electrons or positive ions, one-atom detection is possible. Some examples are given of one-atom detection, including that of the noble gases, in order to show complementarity with AMS methods. For instance, the detection of ^{81}Kr using RIS has interesting applications for solar neutrino research, ice-cap dating, and groundwater dating. 39 refs., 7 figs., 2 tabs.

46797 **(DOE/ER/53188—T1) Experimental investigations of electron capture from atomic hydrogen and deuterium by alpha particles. Annual report, 1 October 1984-30 September 1985.** Gay, T.J. (Missouri Univ., Rolla (USA). Dept. of Physics). 1 Jan 1985. Contract FG02-84ER53188. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014243.

The major effort of this past year has been spent in designing and building the resistor assemblies and controls necessary to modify the UMR ion energy-loss spectrometer for studies of the type described in our original proposal. Specifically, we are interested in the collision $He^{++} + H \rightarrow He^{+}(n) + H^{+}$ and measurement of the total capture cross section as a function of n for He^{++} energies between 25 and 200 keV.

46798 **(INIS-mf—10411) Inner shell ionization by fast protons, alpha particles and carbon ions.** Dijk, J.H. van. (Rijksuniversiteit Groningen (Netherlands)). 12 Oct 1984. 123p. NTIS (US Sales Only), PC A06/MF A01. File Number DE86703113.

The subject of this thesis is the study of inner-shell excitations of atoms induced by fast charged particle collisions. A new method is described for measuring the spectrum of delta-electrons emitted by ^{206}Pb after excitation by 15 MeV protons or 50 MeV alpha particles. Experimental equipment is described. Results of both experiments are presented and compared with PWBA models and with calculations based on a semi-classical approximation. The small-impact-parameter ionization probabilities obtained are then compared with literature. Also small-impact-parameter measurements done with 100 MeV carbon ions are described. Besides K-shell measurements, the author also presents L-subshell ionization probability results for Pb. An appendix is added in which energy straggling problems in solid targets are treated. Includes Dutch summary; 117 refs.; 46 figs.; 19 tabs.

46799 **(IPPJ—728) Some physical differences between sheet plasma and multicusp plasma as volume produced H^- or D^- ion sources.** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1985. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703119.

In the H^- ion volume production by means of a sheet plasma the extracted H^- ion current increases towards the outside across the magnetic field. This fact means that H^- ions are produced outside of the sheet plasma, and is in contrast with the fact that H^- ions in the multicusp plasma are produced almost in the center region without magnetic field. Furthermore, in the optimum condition for extracting H^- ions from the sheet plasma, the potential of the first extraction electrode is biased more negatively than that of the discharge anode or the plasma potential, while, in the optimum condition for the multicusp plasma, it is biased more positively. These physical differences between the two plasmas are related with confinement regions of electrons and ambipolar diffusions of plasma without magnetic field or across magnetic field.

46800 **(IPPJ—730) Measuring method and confirmation of H^-, D^- ion current by sheet plasma, 1.** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1985. 15p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703121.

Usually, it is very difficult to separate an electron current from H^- or D^- ion current under volume production, because both electrons and H^- or D^- ions are extracted from a discharge plasma in H_2 or D_2 gas. However, H^- or D^- ion current by volume production in the sheet plasma can be easily separated from electron current by using the weak magnetic field applied to the sheet plasma itself. Then, if the H^- or D^- ion current is compared with positive ion (mainly H_3^+ or D_3^+) current which is extracted by changing sign of the acceleration voltage from plus (for H^- or D^- ion) to minus, the H^- or D^- ion current can be confirmed more exactly.

46801 **(IPPJ—731) Size effects of vacuum chamber for H^-, D^- ion volume production by sheet plasma, 1.** Uramoto, Joshin. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1985. 17p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703122.

In order to produce H^- (D^-) ions effectively by volume production in the sheet plasma, effects of vacuum chamber are studied by using two sizes of metal vacuum chamber and by changing their bias voltages for the plasma potential of the sheet plasma. Then, we find the H^- (D^-) ion current increases abruptly with distance between the sheet plasma surface and the chamber wall perpendicular to the magnetic field, while it takes a maximum near a floating potential of the chamber (negative for the plasma potential outside of the sheet plasma). These effects are related with a size of space where the plasma potential is higher than those of boundaries parallel and perpendicular to the magnetic field. That is, the H^- (D^-) ion current increases with the spatial size in which H^- (D^-) ions are confined and hydrogen (deuteron) positive ions are lost rapidly along the magnetic field.

46802 **(KU-HCOE-FL2-R—85-27) Low-energy heavy-atom impact as a tool for production and classification of doubly excited states.** Andersen, N. (Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Aarhus Univ. (Denmark). Inst. of Physics). 1985. 9p. (CONF-860148—6). NTIS (US Sales Only), PC A02/MF A01. File Number DE86752094.

From 2. United States/Mexico cooperative symposium on atomic and molecular physics; Cocoyoc, Mexico (1 Jan 1986).

Low-energy heavy-atom impact may be an efficient way of preferentially populating doubly excited levels. Using neon as an example, this paper discusses why this is so. The similarity of the structure of the energy level diagrams for doubly excited neon and the level scheme for neutral magnesium is pointed out, suggesting that collective quantum numbers may describe the electron pair.

46803 **(LA-UR—86-2369) Experimental studies of photon-surface interaction dynamics in the alkali halides.** Haglund, R.F. Jr.; Tolk, N.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy). 1986. Contract W-7405-ENG-36. 11p. (CONF-860880—17). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013852.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

We describe recent measurements which have provided, in unprecedented detail, insights into the electronic mechanisms through which energy carried into a material by photon irradiation is absorbed, localized and rechanneled to produce desorption, surface modification, erosion and damage. The specific object of these studies has been desorption induced by electronic transition in alkali halide crystals, with particular emphasis on the dynamics of changes in the surface and near-surface regions. In our experiments, the irradiating ultraviolet photons are provided by a synchrotron storage ring, and the dynamical information about desorption products is obtained from optical measurements of the quantum states, yields and velocity distributions of neutral ground-state and excited-state atoms ejected from the surface of the irradiating material. These studies have shown that the dominant exit channels in photon-induced particle emission are those producing ground-state

and excited-state neutral atoms. Using dynamical information about these desorbing neutral species, obtained, for example, by laser-induced fluorescence and laser Doppler spectroscopy, we are generating an increasingly comprehensive picture of the dynamics of electronic energy flow into and out of pure crystalline surfaces in these prototypical dielectrics. We are also beginning to be able to relate desorption dynamics to specific materials properties, and to discriminate between pure surface and near-surface effects in these materials. Applications of these techniques to the problem of photon-induced surface damage and to analysis of surface dynamics in dielectric materials are discussed, and the relationships between these nearly ideal model materials and the non-crystalline, covalently bonded materials more typical of real optical elements are pointed out. 19 refs., 13 figs.

46804 (ORNL—6293) Two-photon induced fluorescence and other optical effects in irradiated and doped fused silica. Kramer, S.D. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014422.

The objective of this program was to assess and identify irradiation techniques which could be used to modify the optical characteristics of doped fused silica. Primary emphasis was placed on determining if gamma ray or neutron bombardment of the glass would enhance certain Raman and nonlinear optical effects. In particular, the effect of irradiation on optical two photon induced fluorescence was studied in detail. The maximum radiation exposures used were 10^6 rads (Si) of gamma rays and neutron fluences of 1 x 10^{14} neutrons/cm^2. The optical measurements were made at room temperature between one and four months after irradiation. The maximum input light intensity was 10^9 watts/cm^2 at a near infrared (1.06 μ) input wavelength which was chosen to lie in a transparent spectral region of the glass. Under these experimental conditions a careful search revealed no detectable two-photon induced fluorescence in the region from 550 to 900 nm. The upper limit for the photon efficiency of this process was determined to be less than 1 x 10^{-10}%. 89 refs., 12 figs.

46805 (RAL—84-116) More seminars on muonium spectroscopy. Cox, S.F.J. (Rutherford Appleton Lab., Chilton (UK)). Dec 1984. 75p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86703112.

The paper concerns topics which illustrate the use of muonium spectroscopy in four major areas. The experimental method - muon spin rotation (muSR) is employed in the four topics, which include: muSR studies in magnetism, muons in metals and metal hydrides, muonium in semiconductors and muSR studies in chemistry.

46808 (SAND—86-1751C) Quantum mechanical and classical mechanical calculations of the dynamics of molecular collisions. Schwenke, D.W.; Truhlar, D.G.; Coltrin, M.E. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry; Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 9p. (CONF-8606173—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013573.

From 1. symposium on computational chemistry on cray supercomputers; Minneapolis, MN, USA (11 Jun 1986).

Whenever energy is deposited non-thermally in a system, further evolution of that system is governed by a competition between hot processes and energy relaxation to a Boltzmann distribution. Thus the study of energy transfer in molecular collisions is central to many areas of application including laser-beam energy deposition, laser-beam production, and mode-selective chemistry. Molecular energy relaxation is often dominated by slightly off-resonant vibrational-to-vibrational (V-V) energy transfer. Thus we have embarked on a research project whose long-term goal is the accurate quantum mechanical prediction of V-V energy transfer probabilities in molecular collisions. Such calculations are very difficult and will require at least a class-VI computer for their execution. We have selected HF-HF collisions for detailed study because they have been very widely studied experimentally. A recent compilation of chemical laser systems contains 240 systems of which 190 involve hydrogen halides, and most of these involve HF. The major loss process limiting the efficiency of HF chemical lasers under most conditions are collisional self-deactivation.

46807 Collision strengths and line strengths for all transitions among the levels of the 1s-italic^{2}2s-italic^{2}2p-italic,1s-italic^{2}2s-italic2p-italic^3, and 1s-italic^{2}2p-italic^3 configurations of boron-like ions. Sampson, D.H.; Weaver, G.M.; Goett, S.J.; Zhang, H.; Clark, R.E.H. (Department of Astronomy, Pennsylvania State University University Park, Pennsylvania 16802 Los Alamos National Laboratory, Groups T-4 and X-7 Los Alamos, New Mexico 87545). *Atomic Data and Nuclear Data Tables;* 35: No. 2, 223-266(Sep 1986). Contract FG02-85ER53208.

Collision strengths and electric-dipole line strengths have been calculated for all fine-structure transitions among the levels of the 1s-italic^{2}2s-italic^{2}2p-italic, 1s-italic^{2}2s-italic2p-italic^3, and 1s-italic^{2}2p-italic^3 configurations in 17 boron-like ions with nuclear charge number Z-italic in the range 10< or =Z-italic< or =74. From these results the collision strengths and line strengths for transitions between energy terms and their analogs in j-italicj-italic coupling can also be obtained. The collision strength data cover impact-electron energies < or =3.25Z-italic^2 Ry or 44.2Z-italic^2 eV. The effects of configuration mixing, parentage mixing, and intermediate coupling have been included in the calculations. The method used in calculating the collision strengths is a Coulomb-Born-Exchange method well suited for treating many members of an isoelectronic sequence simultaneously. The complete results have been given in terms of fits to simple functions of the impact-electron energy that are readily integrated over a Maxwellian distribution to obtain collision rates. Some discussion is given of important differences between the present method and the more usual Coulomb-Born-Exchange method, where it is assumed that the free electron sees the screened nuclear charge (Z-italic—N-italic).

46806 Collision strengths and line strengths for all transitions among the levels of the 1s-italic2l-italic2l-italic' configurations of Li-like ions. Zhang, H.; Sampson, D.H.; Clark, R.E.H. (Department of Astronomy, Pennsylvania State University University Park, Pennsylvania 16802). *Atomic Data and Nuclear Data Tables;* 35: No. 2, 267-318(Sep 1986).

Collision strengths and electric-dipole line strengths have been calculated for all fine-structure transitions among the levels of the 1s-italic2l-italic2l-italic' configurations in 19 Li-like ions with nuclear charge number Z-italic in the range 6< or =Z-italic< or =74. From these results the collision strengths and line strengths for transitions between energy terms and their analogs in j-italicj-italic coupling can also be obtained. The collision strength data cover impact-electron energies < or =3.25Z-italic^2 Ry or 44.2Z-italic^2 eV. The effects of configuration mixing, parentage mixing, and intermediate coupling have been included in the calculations. The method used in calculating the collision strengths is a Coulomb-Born-Exchange method well suited for treating many members of an isoelectronic sequence simultaneously. The complete results have been given in terms of fits to simple functions of the impact-electron energy that are readily integrated over a Maxwellian distribution to obtain collision rates.

46809 Experimental apparatus for photon/ion coincidence measurements of dielectronic recombination. Gardner, L.D.; Kohl, J.L.; Lafyatis, G.P.; Young, A.R.; Chutjian, A. (Harvard-Smithsonian Center for Astrophysics, Cambridge, Massachusetts 02138). *Review of Scientific Instruments;* 57: No. 9, 2254-2265(Sep 1986).

An inclined beams apparatus for the measurement of absolute cross sections for dielectronic recombination between free electrons and singly or multiply charged ions is described. The collision products, a photon and a lower-charge-state ion, are detected in delayed coincidence. Measurements of dielectronic recombination in C^{3+} are described to illustrate the use of the apparatus and techniques. Verification of the calibrations and operation of the apparatus is demonstrated through measurements of charge transfer and electron impact excitation.

46810 Orbital forces and chemical bonding in density-functional theory: Application to first-row dimers. Averill, F.W.; Painter, G.S. (Metals and Ceramics Division, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2088-2096(15 Aug 1986). Contract AC05-84OR21400.

The local-density-functional description of chemical bonding in first-row homonuclear dimers is analyzed in terms of both static and dynamic orbital forces. The dynamic orbital force of the i-italicth molecular orbital is equal to the negative of the derivative of the one-electron energy epsilon-c/sub i-italic/ with respect to the p-italicth nuclear coordinate, i.e., -partialepsilon-c/sub i-italic//partialX/sub p/. The static orbital force is also equal to a derivative of the one-electron energy, but the differentiation is carried out with the orbital held fixed, i.e., (-partialepsilon-c/sub i-italic//partialX/sub p/)psi. It is shown that the static force is the orbital's contribution to the total Hellmann-Feynman force, whereas the dynamic force describes the change in the total force due to change in the orbital's occupation number. The chemical bond force in the first-row dimers is observed to be a delicate balance between bonding and antibonding orbital forces. Most of the bond force comes from the 2σ/sub g-italic/ orbital and to a lesser extent from the 1π/sub u-italic/ state. The polarization of the core orbitals in N_2, O_2, and F_2 is found to originate indirectly through their interaction with the 3σ/sub g-italic/ orbital. The dynamic orbital force gives accurate predictions about the change of equilibrium bond distances accompanying electronic ionization and excitation. The formalism and results are related to earlier Hartree-Fock studies.

46811 Alkaline earhtlike spectra in highly ionized members of the Sm isoelectronic sequence. Curtis, L.J. (Department of Physics and Astronomy, Universtiy of Toledo, Toledo, Ohio 43606). *Journal of the Optical Society of America B: Optical Physics;* **3**: No. 8, 1102-1106(Aug 1986).

Energies and radiative transition probabilities have been computed for the 5s-italic^2 ^{1}S-italic/sub o-italic/—5s-italic5p-italic ^{1}/sup ,/^{3}P-italic/sub J-italic/ intervals in highly ionized members of the 62 electron samarium isoelecctronic sequence by using a-italicb-italic i-italicn-italici-italict-italici-italico-italic multiconfiguration Dirac-Fock methods. For Z-italic>74 these become the lowest-lying levels, and the ion assumes an alkalkine earthlike structure. Excitation energies and E1, M1, E2, and M2 transition probabilities for the 5s-italic5p-italic levels are reported for the ions Re^{+13} through U^{+30}. Isoelectronic trends in the relative spacings of the 5s-italic5p-italic levels were also investigated by using semiempirical screening parameterizations of the intermediate coupling equations for the spin—orbit and exchange energies. These trends are compared with systematic regularities noted earlier in the homologous Be, Mg, Zn, and Cd sequences, and possibilities for precise extrapolative predictions are examined.

46812 Transitions of the type 2s-italic-2p-italic in oxygen-like Y, Zr, and Nb. Behring, W.E.; Brown, C.M.; Feldman, U.; Seely, J.F.; Reader, J.; Richardson, M.C. (Laboratory for Solar Physics and Astrophysics, Goddard Space Flight Center, Greenbelt, Maryland 20771). *Journal of the Optical Society of America B: Optical Physics;* **3**: No. 8, 1113-1115(Aug 1986).

Transitions of the type 2s-italic—2p-italic in the oxygenlike ions Y XXXII, Zr XXXIII, and Nb XXXIV were identified in spectra recorded at the University of Rochester's Omega laser facility. Solid targets were spherically irradiated by 24 beams of frequency-tripled (351-nm) Nd:glass laser radiation. The spectra were photographed with a 3-m grazing incidence spectrograph. The identified transitions of the oxygen-like ions are in the range 30 to 73 A-circle. The wavelengths for the magnetic-dipole transitions within the 2s-italic^{2}2p-italic ground configurations of these ions are predicted from the experimental energy levels.

46813 Corrections to van der Waals forces. Manson, J.R.; Ritchie, R.H. (Department of Physics and Astronomy, Clemson University, Clemson, South Carolina 29634). *Physical Review Letters;* **57**: No. 2, 261-261(14 Jul 1986).

A Comment on the Letter by C. K. Au and Richard J. Drachman, Phys. Rev. Lett, 56, 324 (1986).

46814 Evidence for correlated double-electron capture in low-energy collisions of O/sup 6+/ with He. Stolterfoht, N.; Havener, C.C.; Phaneuf, R.A.; Swenson, J.K.; Shafroth, S.M.; Meyer, F.W. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **57**: No. 1, 74-77(7 Jul 1986). Contract AC05-84OR21400.

Production of L-italicM-italicM-italic-Auger and L-italic$_1$L/sub 23/M-Coster-Kronig electrons in 60-keV O/sup 6+/+He and 40-keV C/sup 4+/+He collisions were measured with high resolution by the method of 0° Auger spectroscopy. Oxygen impact is found to create intense Coster-Kronig lines attributed to the configurations 1s-italic^{2}2pnl with n-italic> or =6 which are produced by double-electron capture. Strong evidence is provided that the double-capture process involves electron-correlation effects whose analysis leads beyond the independent-electron model.

46815 Optical pumping of rare-gas metastable atom beams with a frequency modulated multimode dye laser. Lynn, J.G.; Hart, H.W.; Jeys, T.H.; Dunning, F.B. (Rice University, Houston, Texas 77251). *Applied Optics;* **25**: No. 13, 2154-2157(1 Jul 1986).

Very efficient stable optical pumping of an argon metastable atom beam is achieved using a frequency-modulated multimode dye laser. Frequency modulation is accomplished by rapidly oscillating the laser output coupler using a piezoelectric translator. This technique appears attractive for use in optically pumping a wide variety of atomic species.

46816 Molecular physics and chemistry applications of quantum Monte Carlo. Reynolds, P.J.; Barnett, R.N.; Hammond, B.L.; Lester W.A. Jr. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Statistical Physics;* **43**: No. 3, 1017-1026(Jun 1986). Contract AC03-76SF00098.

We discuss recent work with the diffusion quantum Monte Carlo (QMC) method in its application to molecular systems. The formal correspondence of the imaginary-time Schroedinger equation to a diffusion equation allows one to calculate quantum mechanical expectation values as Monte Carlo averages over an ensemble of random walks. We report work on atomic and molecular total energies, as well as properties including electron affinities, binding energies, reaction barriers, and moments of the electronic charge distribution. A brief discussion is given on how standard QMC must be modified for calculating properties. Calculated energies and properties are presented for a number of molecular systems, including He, F, F^-, H_2, N, and N_2. Recent progress in extending the basic QMC approach to the calculation of "analytic" (as opposed to finite-difference) derivatives of the energy is presented, together with an H_2 potential-energy curve obtained using analytic derivatives.

46817 Monte Carlo calculations of atoms and molecules. Schmidt, K.E.; Moskowitz, J.W. (Courant Institute of Mathematical Sciences, 251 Mercer St., New York, N.Y. 10012). *Journal of Statistical Physics;* **43**: No. 3, 1027-1042(Jun 1986).

The variational and Green's function Monte Carlo (GFMC) methods can treat many interesting atomic and molecular problems. These methods can give chemical accuracy for up to 10 or so electrons. The various implementations of the GFMC method, including the domain Green's function method and the short-time approximation, are discussed. Results are presented for several representative atoms and molecules.

46818 Theoretical lifetimes, transition energies, fluorescence yields, and nonradiative branching ratios for highly excited states of lithium-like argon. Bhalla, C.P.; Tunnell, T.W. (Kansas State Univ., Manhattan). *Journal of Quantitative Spectroscopy and Radiative Transfer;* **32**: No. 2, 141-158(1984). Contract AC02-76ER02753.

Theoretical transition rates and transition energies for the states of the excited electron configurations, 1s 2s nl and 1s 2p nl, of lithium-like argon were calculated. The values of n considered range from n = 2 to n = 4 with all allowed values of l included, l

= 0 to l = n-1. Numerical results for the theoretical lifetimes, transition energies, fluorescence yields, and nonradiative branching ratios are given. These quantities are related to the dielectronic recombination rates and cross sections of helium-like argon.

46819 **Electron-impact collision strengths for excitation of He-like ions from the levels with n = 1 and 2 to all singly excited levels with higher n ≦ 5.** Sampson, D.H.; Goett, S.J.; Clark, R.E.H. (Pennsylvania State Univ., University Park). *Atomic Data and Nuclear Data Tables;* **29**: No. 3, 467-534(Nov 1983). Contract AC02-76ET53056.

Intermediate-coupling collision strengths were calculated for all transitions of the kind 1s2p/sup 2S + 1/P/sub J/ - 1sn'l'/sup 2S' + 1/L'/sub J'/ with n' = 3,4 and 5 and l' ≧ 1 (p, d, f, g) for 20 He-like ions with nuclear charge number Z in the range 4 ≦ Z ≦ 74. The method used is a Coulomb-Born-Exchange method especially well suited for calculating results from any members of an isoelectronic sequence simultaneously. The calculations were made for nine impact-electron energies in threshold units epsilon = 1.0, 1.2, 1.5, 1.9, 2.5, 4.0, 6.0, 10.0, and 15.0. The results are given in the form of fits to a simple function of epsilon that is readily integrated over a Maxwellian to obtain collision rates. The parameters required in obtaining collision strengths for the simpler transitions from the 1s2p levels to the 1sn's levels the 3 ≦ n' ≦ 5 and for the transitions from the ground level and the 1s2s levels to all singly excited levels with higher n values ≦ 5 are given, as well. Results for transitions between energy terms and their jj coupling analogs are also included. In addition, calculated values for the transition energies and the electric-dipole radiative line strengths are given for all transitions. 21 references, 11 tables.

6404 Fluid Physics

46820 **(AD-A—168008/1/XAB) GAMBLE-II imploding sodium plasma. 2. Uniformly filled z-pinch. Memorandum report, October 1985-February 1986.** Davis, J.; Rogerson, J.E.; Apruzese, J.P. (Naval Research Lab., Washington, DC (USA)). 8 May 1986. 35p. (NRL-MR—5776). NTIS, PC A03/MF A01.

The dynamics and radiative properties of a GAMBLE II imploded uniformly filled sodium z-pinch plasma are described. Parameters for the initial plasma have been carefully chosen to coincide with current experiments involving a capillary discharge. Results indicate that the sodium helium-like resonance line achieves sufficiently high radiated flux levels to provide an interesting source of radiation for fluorescence and x-ray laser experiments with a comparison neon plasma.

46821 **(DOE/ER/60415—2) Vacuum ultraviolet electronic properties of liquids. Eighteen year progress report, November 1, 1968-January 31, 1987.** Painter, L.R. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). Jul 1986. Contract FG05-86ER60415. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014677.

The principal aim of this program has been to study the electronic structure of liquids over a broad energy range, 2 to 25 eV. These studies basically consist of measuring the reflectance, transmittance, photoionization and photoemission of liquids in the vacuum ultraviolet spectral region as a function of angle of incidence and photon energy. Such measurements are analyzed to yield the optical and dielectric functions of the liquid as functions of photon energy. These functions describe electron motion in liquids as stimulated by nuclear radiation, visible and ultraviolet light, and charged particles. A knowledge of the interactions of radiation with molecular liquids has direct biological application in terms of understanding radiation damage to living material, to radiotherapy, to radiation dosimetry, to problems in cell biology, and to calculation of the actual degree of adhesive interactions between biological cells and between cells and artificial matter. Applications are made to radiation chemistry, upper atmospheric physics, and aerosol formation. 31 refs.

46822 **(SAND—85-2707C) Numerical solutions to creeping flow equations. Part 1. Falling ball rheometry.** Wagner, N.; Mondy, L.A.; Miller, J.D.; Graham, A.L.; Cook, W.A. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering; Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36;AC04-76DP00789. 16p. (CONF-860760—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014142.

From 17. annual meeting of the Fine Particle Society; San Francisco, CA, USA (28 Jul 1986).

Numerical solutions are described for the velocity and stress fields in a viscous Newtonian liquid contained in a cylindrical vessel during the passage of a solid sphere settling under the influence of gravity. By taking advantage of the mathematical analogy between incompressible creeping flow of a Newtonian liquid and incompressible elasticity in a Hookean solid, we use advanced, finite element, computer programs developed for solid mechanics to perform creeping flow calculations. The drag on the sphere, in an unbounded fluid, would be given by Stokes' law. Using finite element stress codes we calculate the additional drag on the sphere due to the presence of the containing walls of the cylinder and the upper free surface of the liquid. Good agreement with experimental data and with analytical calculations is obtained for a range of ball sizes. Our findings indicate that the finite element method is an accurate computational technique for solving this class of multiphase hydrodynamics problems.

46823 **(UCRL—94277) 2D Lagrange MHD code.** Tipton, R.E. (Lawrence Livermore National Lab., CA (USA)). Jul 1986. Contract W-7405-ENG-48. 10p. (CONF-860703—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014440.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

An MHD model has been implemented on a 2D Lagrangian mesh with cylindrical symmetry. The magnetic diffusion equations for both B/sub θ/ and B/sub r'/, B/sub z/ are solved. The code has been used to model several simple experiments involving induced currents in conducting rings. The calculated results have been compared with the experimental data. The goal of this research is to develop a detailed computational model to aid in the design of High Explosive Generators. 8 refs., 3 figs.

46824 **(UCRL—94800) Direct computation of wall bounded aerosol turbulent flow interactions.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 16p. (CONF-8609116—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013221.

From 3. international conference on numerical methods for non-linear problems; Dubrovnik, Yugoslavia (15 Sep 1986).

A method is described for direct numerical simulations of the statistical interactions between spherical solid particles and a turbulent carrier gas that entrains them. At the present stage of method development, the emphasis is on analysis of wall bounded turbulent, two phase, compressible flow. The bounding geometry described here is a two dimensional channel. The numerical procedure is designed to resolve statistical flow features of both dispersed and continuous phases. The numerical simulations combine a truncated spectral transform collocation procedure for the continuous phase with a Monte Carlo Lagrangian procedure for the dispersed phase. The continuous phase is iteratively matched at discrete time intervals to a random-walk Lagrangian statistical sampling procedure for the dispersed phase momenta and position expectancies. Ensemble averaging produces statistical velocity moments for both dispersed and continuous phases. 20 refs., 8 figs.

46825 **Desingularization of periodic vortex sheet roll-up.** Krasny, R. (Courant Institute of Mathematical Sciences, New York University 251 Mercer Street, New York, New York 10012). *Journal of Computational Physics;* **65**: No. 2, 292-313(Aug 1986).

The equations governing periodic vortex sheet roll-up from analytic initial data are desingularized. Linear stability analysis shows that this diminishes the vortex sheet model's short wave-

length instability, yielding a numerically more tractable set of equations. Computational evidence is presented which indicates that this approximation converges, beyond the critical time of singularity formation in the vortex sheet, if the mesh is refined and the smoothing parameter is reduced in the proper order. The results suggest that the vortex sheet rolls up into a double branched spiral past the critical time. It is demonstrated that either higher machine precision or a spectra filter can be used to maintain computational accuracy as the smoothing parameter is decreased. Some conjectures on the model's long time asymptotic state are given.

46826 **FLIP: A method for adaptively zoned, particle-in-cell calculations of fluid in two dimensions.** Brackbill, J.U.; Ruppel, H.M. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* 65: No. 2, 314-343(Aug 1986).

A method is presented for calculating fluid flow in two dimensions using a full particle-in-cell representation on an adaptively zoned grid. The method has many interesting properties, among them an almost total absence of numerical dissipation and the ability to represent large variations in the data. The method is described using a standard formalism and its properties are illustrated by supersonic flow over a step and the interaction of a shock with a thin foil.

46827 **Velocity of propagation of the ^{3}He-A-italic-B-italic interface in hypercooled ^{3}He-A-italic.** Buchanan, D.S.; Swift, G.W.; Wheatley, J.C. (Condensed Matter and Thermal Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* 57: No. 3, 341-344(21 Jul 1986).

We have measured the velocity of propagation of the ^{3}He A-italic-B-italic interface as a function of temperature and pressure for the ^{3}He-A-italic initially in a hypercooled state. Velocities as high as 67 cm/s have been observed. Nucleation of the A-italic phase occurred at greatly different temperatures in two different regions of the experimental cell.

46828 **Fourier path integral methods: A model study of simple fluids.** Freeman, D.L.; Coalson, R.D.; Doll, J.D. (Department of Chemistry, University of Rhode Island, Kingston, Rhode Island 02881). *Journal of Statistical Physics;* 43: No. 3, 931-934(Jun 1986).

The free energy of normal liquid helium is calculated. (AIP)

46829 **Simplified kinetic treatment of heavy molecule velocity persistence effects: application to species separation.** de la Mora, J.F.; Mercer, J.; Rosner, D.E.; Fenn, J.B. (Yale Univ., New Haven, CT). *Progress in Astronautics and Aeronautics;* 74: 617-626(1981). Contract FG01-78ET11384.

From 12. international symposium on rarefied gas dynamics; Charlottesville, VA, USA (7-11 Jul 1980).

A formalism is supplied to account for inertial non-equilibrium in dilute mixtures of heavy molecules in a light bath. It is shown that the usual local gradient flux laws are not valid in situations typical of aerodynamic species separation experiments. A more general framework, including the inertia of the heavy species, is introduced based on a Fokker-Planck kinetic equation, which the authors solve approximately for the two-dimensional stagnation point flow prevailing in the opposed jet geometry. The predictions compare favorably with available experiments and, on the basis of this formulation, specific recommendations for future experiments are made. 12 references, 3 figures.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 46452

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 46421, 46422, 46424, 46451, 46512, 46902, 46913

46830 (ANL—85-22, pp 8) **Electroproduction of the delta isobar in nuclei.** Geesaman, D.F.; Green, M.C.; Holt, R.J.; Jackson, H.E.; Kowalczyk, R.S.; Lee, T.S.H.; Schiffer, J.P.; Zeidman, B. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

A study of the electroproduction of the delta isobar in complex nuclei has been proposed and approved at the Stanford Linear Accelerator (SLAC). The 1.6-GeV and 8-GeV spectrometers will be used to investigate the scattering of medium-energy electrons (T/sub e/ = 0.5 to 2.0 GeV) by targets of ^{12}C and ^{56}Fe. The particular feature to be studied in this experiment will be the separation of the longitudinal and transverse cross sections at relatively low four-momentum transfer, $q^2 \sim 0.1$ (GeV/c)^2, where the kinematic conditions correspond to those obtained in pion excitation of the delta.

46831 (ANL—85-22, pp 34-35) **Neutrino oscillations at LAMPF.** Carlini, R.; Choi, C.; Donohue, J.; Fazely, A.; Freedman, S.J.; Fujikawa, B.; Garvey, G.T.; Green, M.; Harper, R.; Imlay, R.; Lesko, K. (Los Alamos National Lab., NM). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Work at Argonne continues on the construction of the neutrino oscillation experiment (E645). Construction of detector supports and active shield components were completed at the Provo plant of the principal contractor for the project (the Pittsburgh-Des Moines Corporation). Erection of the major experimental components was completed at the LAMPF experimental site in mid-March 1985. Work continues on the tunnel which will house the detector. Construction of detector components (scintillators and proportional drift tubes) is proceeding at Ohio State University and Louisiana State University. Consolidation of these components into the 20-ton neutrino detector is beginning at LAMPF.

46832 (ANL—85-22, pp 37) **Neutron beta decay.** Freedman, S.J.; Bopp, P.; Dubbers, D.; Honig, L.; Klempt, E.; Last, J.; Schaerp, O. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Data acquisition on the neutron β-decay experiment was accomplished during three six-week reactor cycles during 1983. The experiment runs were completed on October 4, 1983; the reactor is now shut down for a year of refitting.

46833 (ANL—85-22, pp 41-42) **Search for super-heavy particles in cosmic rays.** Dawson, J.; Freedman, S.J.; Gobbi, B.; Kroupa, M.; Napolitano, J. Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Magnetic monopoles with masses on the order of 10^{16} GeV/c^2 are predicted by Grand Unified field theories. Some astrophysical predictions of production rates of these objects in the early universe suggest an observable abundance in the present universe. Our search for these heavy magnetic monopoles consists of a layered array of large-area plastic-scintillator counters with a geometrical factor of 3.8 m^2-ster. These counters, used previously in a search for low ionization by fractionally charged particles, are sensitive to single photons or about 1.5% of the ionization of single minimum-

ionizing particles. In a series of runs with a total active time of 230 days the authors observed no candidate events and can assign a 90% confidence limit of 4.1 x 10^{-12}/cm^2-s-sr to the flux of these particles at the earth's surface for highly ionizing particles.

46834 (ANL—85-22, pp 44-45) **Measurement of the electric dipole moment of the neutron.** Freedman, M.S.; Ringo, G.R.; Dombeck, T.W.; Carpenter, J.M.; Jarmie, N.; Lynn, J.W.; Moses, J.D. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The purpose of this project is to measure the electric dipole moment (EDM) of the neutron. Such a measurement would probably constitute the most sensitive test of time-reversal symmetry now available. The present situation is that with about a factor-of-10 improvement in sensitivity, a whole class of gauge theories - those which explain CP failure by introducing a new scalar field - can be given a definitive test. Since the measurement of the neutron EDM is fundamentally a frequency measurement, its statistical uncertainty is inversely proportional to the duration of the measurement. It is therefore natural to try the measurement on ultracold neutrons (UCN). The present state of the project is that the basic experimental ideas have been tested and shown to be practical, as have several other ideas for enhancing the production of UCN, such as the use of reflectors around the moving crystal and funnels to concentrate the UCN in real space at the expense of their concentration in velocity space. Although it was originally planned to do the experiment at IPNS, difficulties with cold moderators and the availability of a higher flux source at Los Alamos have caused us to move the experiment there.

46835 (BNL—38285) **Antinucleon physics.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.). 1986. Contract AC02-76CH00016. 22p. (CONF-860575—23). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013913.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Some of the recent data from LEAR, Brookhaven, and KEK on low and medium energy interactions of antinucleons (anti N) with nucleons (N) are reviewed and interpreted. Emphasis is on elastic and charge exchange scattering, total cross sections, and studies of anti NN annihilation, with particular focus on the emerging evidence for broad resonances and/or bound states of the anti NN system and the selection rules which reveal the quuark-gluon dynamics of the annihilation process. 69 refs., 8 figs.

46836 (BNL—38304) **Spin effects in exclusive reactions at high P/sub perpendicular/.** Makdisi, Y. (Brookhaven National Lab., Upton, NY (USA). AGS Dept.). 1986. Contract AC02-76CH00016. 6p. (CONF-860575—29). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014131.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Production and decay angular distributions from the process $\pi^- p \rightarrow rho^- p$ at 90° in the center-of-mass are presented. A large spin flip amplitude is observed, the ramifications of which are noted in the contex of the known theories.

46837 (BNL—38385) **Search for the ξ(2.2) in anti pp formation.** Christenson, J.H.; Kreiter, G.A.; Nemethy, P.; Sculli, J.; Yamin, P. (New York Univ., NY (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA). AGS Dept.). 1986. Contract AC02-76CH00016. 9p. (CONF-860701—7). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014167.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The results are reported of a search at the Brookhaven National Laboratory AGS for the ξ(2.2) with a mass resolution of 3 MeV/c^2. Thirty-seven thousand events of the form anti pp → K^+K^- and two hundred thousand events of the form anti pp → $\pi^+\pi^-$ were studied in the incident momentum interval from 1.25 GeV/c to 1.56 GeV/c, corresponding to a mass interval of 110 MeV/c^2 about the reported ξ mass.

46838 (DOE/ER/40048—163-L6) **Parity and time-reversal violation in nuclei and atoms.** Adelberger, E.G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1986. Contract AC06-81ER40048. 12p. (CONF-860575—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013146.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

Two topics are briefly reviewed: the parity (P)-violating NN interaction and the time-reversal (T) and P-violating electric moments (EDM's) of atoms. The ΔI = 1 P-violating NN amplitude dominated by weak π^{+-} exchange is found to be appreciably smaller than bag-model predictions. This may be a dynamical symmetry of flavor-conserving hadronic weak processes reminiscent of the ΔI = 1/2 rule in flavor-changing decays. General principles of experimental searches for atomic EDM's are discussed. Atomic EDM's are sensitive to electronic or nuclear EDM's and to a P-and-T-violating electron-quark interaction. Even though the experimental precision is still $\sim 10^4$ times worse than counting statistics, the recent results have reached a sensitivity to nuclear EDM's which rivals that of the neutron EDM data. Further significant improvements can be expected. 17 refs., 4 figs.

46839 (FNAL/C—86/102-E) **Azimuthal energy flow in deep inelastic neutrino scattering.** Mukherjee, A.; Bofill, J.; Busza, W.; Eldridge, T.F.; Friedman, J.I.; Fuess, S.; Goodman, M.C.; Kendall, H.W.; Lyons, T.F.; Magahiz, R.A. (Massachusetts Inst. of Tech., Cambridge (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Michigan State Univ., East Lansing (USA); Florida Univ., Gainesville (USA)). 12 Jun 1986. Contract AC02-76CH03000. 16p. (CONF-860701—8). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014372.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

Gluon emission and the transverse momentum (p/sub t/) of partons confined in nucleons were studied using deep-inelastic charged-current neutrino-nucleon interactions. For this analysis we use the flow of hadronic energy in the azimuthal direction around the momentum transfer referenced from the neutrino-muon scattering plane. A five standard deviation asymmetry was found. Analysis of this asymmetry indicates a (p/sub t/) of 0.35 +- 0.12 GeV/c if QCD corrections are included, and 0.56 +- 0.05 GeV/c if they are excluded. Some evidence was also observed for x dependence in p/sub t/. Data were taken at Fermilab in 1982 using a 200 ton (fiducial mass) fine grained calorimeter and a dichromatic neutrino beam.

46840 (LA—10655-C, pp 41-62) **Neutrino electron scattering at LAMPF.** White, D.H. (Brookhaven National Lab., Upton, NY). Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

A major accomplishment in elementary particle physics in the last fifteen years has been the success of the electroweak model of Glashow, Weinberg, and Salam in describing the unification of the electromagnetic and weak forces. The theory explains the experimental facts within the precision with which they are known in terms of a single phenomenological parameter. Many deeper uncertainties remain, particularly the origin of the masses of the intermediate vector bosons, but here the authors shall consider the limits of applicability of the standard model assuming that verifying the theory is a worthwhile goal and that exposing limitations of the theory may cast light on the deeper aspects, which are yet speculative. The theory is described below from an experimenter's point of view, with heavy emphasis on the observables, including a summary of the present experimental situation and a proposal for a new measurement of theta/sub W/ at LAMPF.

46841 (LA—10655-C, pp 63-94) **Searching for muon number violating at LAMPF: current results and future prospects.** Cooper, M.D. Feb 1986. NTIS, PC A10/MF A01. File Number DE86008572.

In Proceedings of the nineteenth LAMPF Users Group meeting.

The experimental status of rare decays that violate muon number conservation is summarized. These results represent an international effort in this active field, with experiments at laboratories in the United States, Switzerland, Canada, and the Soviet Union. Substantial improvements over the data of two years ago are shown that demonstrate the present knowledge for the four muon processes. As many of these experiments are still running or coming into operation, immanent progress to the level stated in column four is expected. The last column shows that new experiments are being planning now that should yield results around 1990. This paper will focus on the present and future prospects for the decays $\mu^+ \rightarrow e^+\gamma$ and $\mu^+ \rightarrow e^+\gamma\gamma$ that are being pursued at LAMPF. The experimental apparatus is described.

46842 (LBL—21716) Direct lepton production in hadronic and nuclear collisions at low p/sub t/ and low pair mass. Roche, G. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 10p. (CONF-860575—22). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013472.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A brief review of the direct production of single leptons and dileptons in hadronic collisions at low p/sub t/ and low pair mass is given. Several open questions are pointed out and the universality of lepton production is briefly discussed. The Bevalac Di-Lepton Spectrometer project is presented. 25 refs., 5 figs.

46843 (RRK—85-3) Unconstrained multiplet in N=2 conformal supergravity. Hayashi, Masahito; Uehara, Shozo. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics; Kyoto Univ. (Japan). Dept. of Physics). Feb 1985. 42p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703139.

An unconstrained (general) multiplet was studied in N = 2 conformal supergravity. Transformation law, embedding formula and multiplication rule are explicitly presented at the linearized level.

46844 (SLAC—300) Measurement of the average lifetime of hadrons containing bottom quarks. Klem, D.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1986. Contract AC03-76SF00515. 73p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86014070.

Thesis.

This thesis reports a measurement of the average lifetime of hadrons containing bottom quarks. It is based on data taken with the DELCO detector at the PEP e^+e^- storage ring at a center of mass energy of 29 GeV. The decays of hadrons containing bottom quarks are tagged in hadronic events by the presence of electrons with a large component of momentum transverse to the event axis. Such electrons are identified in the DELCO detector by an atmospheric pressure Cherenkov counter assisted by a lead/scintillator electromagnetic shower counter. The lifetime measured is 1.17 psec, consistent with previous measurements. This measurement, in conjunction with a limit on the non-charm branching ratio in b-decay obtained by other experiments, can be used to constrain the magnitude of the V/sub cb/ element of the Kobayashi-Maskawa matrix to the range 0.042 (+0.005 or -0.004 (stat.), +0.004 or -0.002 (sys.)), where the errors reflect the uncertainty on tau/sub b/ only and not the uncertainties in the calculations which relate the b-lifetime and the element of the Kobayashi-Maskawa matrix.

46845 Forward-angle cross sections for pion-nucleon charge exchange between 100 and 150 MeV/c-italic. Fitzgerald, D.H.; Baer, H.W.; Bowman, J.D.; Cooper, M.D.; Irom, F.; King, N.S.P.; Leitch, M.J.; Piasetzky, E.; Briscoe, W.J.; Sadler, M.E.; Smith, K.J.; Knudson, J.N. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **34**: No. 2, 619-626(Aug 1986).

The differential cross sections for the πN charge-exchange reaction, $\pi^- p \rightarrow \pi^0 n$, have been measured in an angular range corresponding to 0.99> or =cost-italich-italice-italict-italica-italic/sub c.m./> or =0.90 at 100.6, 106.7, 113.4, 125.2, 130.9, 136.4, and 147.1 MeV/c-italic. A striking feature of the charge-exchange reaction at forward angles is the presence of a deep minimum near 120 MeV/c-italic, caused by interference between s-italic- and p-italic-wave scattering. The parameters of this minimum, of interest both intrinsically and for applications to π-nucleus single- and double-charge-exchange reactions, are well determined by the measurements. Our data are compared with the results of existing partial-wave analyses, and the data are discussed in terms of the isospin-odd, s-italic-wave scattering length, a-italic$_1$-a$_3$.

46846 Measurement of elastic electron scattering from the proton at high momentum transfer. Arnold, R.G.; Bosted, P.E.; Chang, C.C.; Gomez, J.; Katramatou, A.T.; Martoff, C.J.; Petratos, G.G.; Rahbar, A.A.; Rock, S.E.; Sill, A.F.; Szalata, Z.M.; Sherden, D.J.; Lambert, J.M.; Lombard-Nelsen, R.M. (Department of Physics, The American University, Washington D.C. 20016). *Physical Review Letters;* **57**: No. 2, 174-177(14 Jul 1986).

We have performed absolute measurements of the differential cross section for elastic e-italic-p-italic scattering in the range of momentum transfer from Q-italic^2 = 2.9 to 31.3 (GeV/c-italic)^2. Combined statistical and systematic uncertainties in the cross-section measurements ranged from 3% at low Q-italic^2 to 19% at high Q-italic^2. These data have been used to extract the proton magnetic form factor G-italic/sub M-italic//sup p-italic/(Q^2). The results show a smooth decrease of Q-italic^{4}G/sub M//sup p/ with momentum transfer above Q-italic^2 = 10 (GeV/c-italic)^2. These results are compared with recent predictions of perturbative QCD.

46847 Production of G(1590) and other mesons decaying into eta pairs by 100 GeV/c πp on protons. Alde, D.; Knapp, E.A.; Donskov, S.V.; Inyakin, A.V.; Kachanov, V.A.; Kakauridze, D.B.; Khaustov, G.V.; Kulik, A.V.; Lednev, A.A.; Mikhailov, Yu.V. (Los Alamos National Lab., NM, USA). *Nuclear Physics* [*Section*] *B;* **269**: No. 2, 485-508(2 Jun 1986).

New data on the scalar G(1590) meson which decays into etaeta have been obtained in an experiment at the CERN SPS. eta pairs are detected with the electromagnetic calorimeter GAMS both through their decay into 4γ and into 8γ. epsilon(1300), f(1270), f(1525) as well as the spin-4 h(2030) mesons have also been observed to decay in the same mode. Their branching ratios have been evaluated. The presence of high-mass spin-O and spin-2 structures is discussed.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 46430, 46430, 46835, 46875, 46887

46848 (INS—536) Composite models of 'elementary' particles and fields. Terazawa, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Apr 1985. 49p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703137.

Composite models of "elementary" particles and fields, leptons, quarks, and gauge bosons (and also Higgs scalars, if any), are reviewed and discussed in a pedagogical way.

46849 (LBL—21695) Identifying heavy Higgs bosons. Cahn, R.N. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 4p. (CONF-8605163—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013487.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

Two techniques for identifying heavy Higgs bosons produced at SSC energies are discussed. In the first, the Higgs boson decays into ZZ, with one Z decaying into an e-pair or μ-pair and the other into a neutrino pair. In the second, the production of the Higgs boson by WW fusion is tagged by detecting the quarks that produced the bremsstrahlung virtual W's. The associated Higgs decay is identified by one leptonic and one hadronic decay. Both methods appear capable of finding a heavy Higgs boson provided the SSC design parameters are achieved. 16 refs., 2 figs., 2 tabs.

46850 (RRK—85-9) Axial weak currents in the Wess-Zumino term. Fujikawa, Kazuo. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Mar 1985. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703138.

The conventional axial gauging of the Wess-Zumino term leads to the results which do not necessarily agree with the expectations on the basis of quark level Ward-Takahashi identities. This discrepancy arises from the fact that the quark level anomalous identities reflect the short distance structure of QCD, whereas the gauging of the Wess-Zumino term reflects the axial symmetry in the spontaneously broken chiral phase. The low energy theorem for axial weak fields is not sharply defined, in contrast to the case of vector fields where no such complications arise.

46851 (SLAC-PUB—4001) CP violation in B and D decays. Bigi, I.I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jun 1986. Contract AC03-76SF00515. 8p. (CONF-8605162—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012959.

From International symposium on production and decay of heavy flavours; Heidelberg, F.R. Germany (19 May 1986).

Non-leptonic B decays offer the best opportunity to discover the violation of CP invariance outside the neutral K system. Employing the Standard Model one predicts - with reasonable confidence - CP asymmetries of up to 20% (or even more in some cases). The branching ratios for the individual exclusive modes of interest are not expected to exceed the 10^{-3} level in most cases; the identification of such decays poses non-trivial problems. It is shown that by summing intelligently over appropriate classes of decays one can greatly enhance statistics without jeopardizing the signal. Data that contain 10^6 produced B mesons would allow meaningful searches for CP violation. It is noted that "New Physics" could lead to CP asymmetries in D^0 decays of order 1%. Due to higher branching ratios one can search for such effects in samples of 10^6 produced D mesons. 7 refs.

46852 (SLAC-TN—86-3) Hadron cascade code, FLUKA82: setup and coupling with EGS4 at SLAC. Ranft, J.; Moehring, H.J.; Jenkins, T.M.; Nelson, W.R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Apr 1986. Contract AC03-76SF00515. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014388.

This note describes a SLAC implementation of the FLUKA hadronic cascade code coupled with the EGS4 electromagnetic cascade code. As an example of the use of FLUKA-EGS, the momentum distribution of π^+ mesons produced by 18 GeV electrons striking a 0.3 r.l. beryllium target is calculated and successfully compared with the experimental results taken from the SLAC Users Handbook.

46853 Quark confinement and hadronic interactions. Lenz, F.; Londergan, J.T.; Moniz, E.J.; Rosenfelder, R.; Stingl, M.; Yazaki, K. (Swiss Institute for Nuclear Research (SIN), CH-5234 Villigen, Switzerland). *Annals of Physics (New York);* 170: No. 1, 65-254(Aug 1986).

A study of quark models for many-hadron systems is presented. The starting point in the construction of these nonrelativistic models is a proper formal definition of the concept of color singlet and nonsinglet clusters in a multiquark system which respects the exchange symmetry of the quarks. This definition provides a natural way to impose saturation of the confining forces.

46854 New interaction for the enhancement of the ΔI-italic = (1/2) amplitude in weak decays. Ma, E. (Department of Physics, University of California, Davis, California 95616 and Department of Physics and Astronomy, University of Hawaii at Manoa, Honolulu, Hawaii 96822). *Physical Review Letters;* 57: No. 3, 287-289(21 Jul 1986).

The low-energy limit of superstring theory admits certain new quarks and scalar bosons. Their interaction with the known quarks may lead to a significant enhancement of the ΔI-italic = (1/2) amplitude in weak decays.

46855 Can the data from the CERN p-italicp-bar collider limit gaugino masses?. Baer, H.; Hagiwara, K.; Tata, X. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439;). *Physical Review Letters;* 57: No. 3, 294-297(21 Jul 1986). Contract W-31-109-ENG-38;FG06-85ER40224.

We show that the hadronic decays of the W-italic gaugino (W-italic-tilde) and Z-italic gaugino (Z-italic-tilde) produced via each of the processes W-italic→W-italic-tildegamma-tilde, W-italic→W-italic-tildeZ-italic-tilde, and Z-italic°W-tildeW-tilde lead to a substantial monojet and dijet + missing p-italic/sub T-italic/ rate at the CERN collider. If the latter two decays are kinematically allowed, one should expect a comparable number of spectacular dilepton and trilepton events with little hadronic activity. In addition, there would also be jet + lepton + missing p-italic/sub T-italic/ signals. Absence of such signals could lead to the most stringent direct experimental limits on W-italic-tilde and Z-italic-tilde masses currently possible.

46856 Neutral-meson-antimeson mixing for a heavy isosinglet quark constituent. Barger, V.; Phillips, R.J.N.; Whisnant, K. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* 57: No. 1, 48-50(7 Jul 1986).

If there exists a heavy isosinglet h-italic quark that mixes with the d-italic quark in the weak eigenstates, then the neutral meson H-italic°(hd-bar) can mix maximally with its antiparticle H-bar°(h-bard) through lowest-order flavor-changing neutral currents regardless of how small the h-italic-d-italic mixing angle may be. The H-italic°-H-bar° mixing parameter ε depends essentially on the H-italic° mass; for m-italic/sub H-italic/<25 GeV, ε can be as large as 0.4.

46857 Cross section for four-gluon production by gluon-gluon fusion. Parke, S.J.; Taylor, T.R. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Physics [Section] B;* 269: No. 2, 410-420(2 Jun 1986).

The cross section for two-gluon to four-gluon scattering is given in a form suitable for fast numerical calculations.

46858 QCD radiative corrections to parton-parton scattering. Ellis, R.K.; Sexton, J.C. (Fermi National Accelerator Lab., Batavia, IL, USA). *Nuclear Physics [Section] B;* 269: No. 2, 445-484(2 Jun 1986).

We present the matrix elements squared for all (2->2) and (2->3) parton scattering subprocesses calculated at $O(\alpha sub(s)^3)$. The matrix elements are presented in n dimensions to regulate singularities due to the emission of soft or collinear radiation. We use these results to discuss one-hadron inclusive scattering, considering only a limited number of parton subprocesses. A preliminary analysis is made of the implications of our results for gluon-gluon scattering in the absence of quarks.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 46838, 46854, 46874, 46876, 46878, 46879, 46893

46859 (LA-UR—86-2540) Test of time reversal symmetry with resonance neutron scattering. Bowman, J.D. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 5p. (CONF-860575—26). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013831.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The possibility of searching for time-reversal symmetry violation in the scattering of epithermal neutrons from nuclei is discussed. Sources of both statistical and systematic errors are reviewed. A qualitative assessment of the size of the time reversal is made and a schematic design of an experiment to test time reversal symmetry is presented. (DWL) 10 refs., 1 fig.

46860 **Phenomenologically consistent discrete symmetries in superstring theories.** Joshipura, A.S.; Sarkar, U. (Institute of Mathematical Sciences, Madras 600113, India). *Physical Review Letters;* **57**: No. 1, 33-36(7 Jul 1986).

The light matter supermultiplets are specified uniquely in most superstring theories when compactified on Calabi-Yau manifolds. It is pointed out that the discrete symmetries considered earlier in these models cannot give rise to a phenomenologically consistent fermion mass spectrum and suppress fast proton decay. We propose here a simple model which demonstrates the type of discrete symmetries one has to look for to make the superstring theories phenomenologically acceptable. Some interesting consequences of the model are pointed out.

46861 **Effect of self-consistent treatment of one-gluon exchange in the Freidberg-Leenor-topological soliton model.** Haider, Q.; Liu, L.C. (Los Alamos National Lab., NM, USA). *Journal of Physics G: Nuclear Physics;* **12**: No. 3, L75-L81(Mar 1986). Contract W-7405-ENG-36.

The effects of one-gluon exchange on the static properties of ground-state hadrons have been examined in detail within the framework of Friedberg-Lee non-topological soliton model. It is noted that the perturbative approach, employed in many bag models, is inadequate. A self-consistent non-perturbative procedure for calculating one-gluon exchange is proposed.

6454 Field Theory

REFER ALSO TO CITATION(S) 46848, 46855, 46860, 46996, 47022

46862 **(DOE/ER/03992—554) Renormalization group analyses of an SU(2) lattice guage theory.** Eubank, S.; Chiu, C. (Texas Univ., Austin (USA). Center for Particle Theory). May 1984. Contract AS05-76ER03992. 34p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014632.

Using Migdal's recursion relation for renormalization group calculations, we describe an approximation for the average value of a Wilson loop and calculate ka^2 vs $1/g^2$ for SU(2) actions of the form s/sub p/ = -2(β/sub f/ cos θ/2 + β/sub a/ cos θ). We use loops as large as 40 x 40 on a 4-dimensional lattice. We also find evidence for a phase transition in the region β/sub a/ ~ -2, β/sub f/ > 0.7 using Tan and Xu's modification of the recursion relation. 14 refs., 7 figs.

46863 **(DOE/ER/03992—578) Renormalization of the axial vector current in QCD.** Chiu, C.B.; Pasupathy, J.; Wilson, S.L. (Texas Univ., Austin (USA). Center for Particle Theory; Indian Inst. of Science, Bangalore. Centre for Theoretical Studies). Feb 1985. Contract AS05-76ER03992. 34p. (CPT—85-002). NTIS, PC A03/MF A01; GPO Dep. File Number DE86014621.

Following the method of Ioffe and Smilga, the propagation of the baryon current in an external constant axial-vector-field is considered. The close similarity of the operator-product-expansion with and without an external field is shown to arise from the chiral invariance of gauge interactions in perturbation theory. Several sum rules corresponding to various invariants both for the nucleon and the hyperons are derived. The analysis of the sum rules is carried out by two independent methods, one called the ratio method and the other called the continuum method, paying special attention to the nondiagonal transitions induced by the external field between the ground state and excited states. Up to operators of dimension six, two new external-field-induced vacuum expectation values enter the calculations. Previous work determining these expectation values from PCAC are utilized. Our determination from the sum rules of the nucleon axial-vector renormalization constant G/sub A/, as well as the Cabibbo coupling constants in the SU_3 symmetric limit (m/sub s/ = 0), is in reasonable accord with the experimental values. Uncertainties in the analysis are pointed out. The case of broken flavor SU_3 symmetry is also considered. While in the ratio method, the results are stable for variation of the fiducial interval of the Borel mass parameter over which the left-hand-side and the right-hand-side of the sum rules are matched, in the continuum method the results are less stable. Another set of sum rules determines the value of the linear combination 7F - 5D to be ≃ 0, or D/(F + D) ≃ 7/12. 17 refs., 16 figs.

46864 **(DOE/ER/40048—29-N6) New force in nature.** Fischbach, E.; Sudarsky, D.; Szafer, A.; Talmadge, C.; Aronson, S.H. (Washington Univ., Seattle (USA). Dept. of Physics; Purdue Univ., Lafayette, IN (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA). Physics Dept.; European Organization for Nuclear Research, Geneva (Switzerland)). 1986. Contract AC06-81ER40048. 17p. (CONF-860575—32). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014284.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

We review recent experimental and theoretical work dealing with the proposed fifth force. Further analysis of the original Eotvos experiments has uncovered no challenges to our original assertion that these data evidence a correlation characteristic of the presence of a new coupling to baryon number or hypercharge. Various models suggest that the proposed fifth force could be accommodated naturally into the existing theoretical framework. 40 refs.

46865 **(DOE/ER/40233—T1) Topics in gauge theories and unification of elementary particle interactions.** Srivastava, Y.N.; Vaughn, M.T. (Northwestern Univ., Chicago, IL (USA)). 4 Apr 1986. Contract FG02-85ER40233. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013957.

The proposed research includes work on (1) jets in minimum bias, (2) quantum Hall effect and applications of quantum electrodynamics to microelectronics and (3) renormalization group analysis of unified gauge theories. In addition, rates were computed for vector boson decay modes of the nucleon in N=1 supergravity models, and is doing further work on supersymmetric signals at SLC and LEP, and on superstring phenomenology.

46866 **(DOE/ER/45144—T2) [Research in the theory of condensed matter and elementary particles.] Progress report.** (Chicago Univ., IL (USA)). [1986]. Contract FG02-84ER45144. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86013958.

Progress is summarized in these areas: a new formulation of two dimensional critical phenomena and string theory, supersymmetric critical phenomena and string compactification, conformal field theory on orbifolds, Gaussian models with twisted boundary conditions, modular invariance and supersymmetric critical phenomena, critical indices, conformal invariance, and current algebra, renormalization group fixed points and the string equation of motion, fermionic string field theory, N = 2 super Riemann surfaces, the spinor field in covariant superstring theory, covariant quantization of superstrings, models of aggregation, and quasi-supersymmetry in the BCS mechanism. Further work is proposed in the areas of two dimensional critical phenomena, two dimensional conformal field theory and string theory, the physics of computation, models of aggregation, and the many vortex Aharonov-Bohm problem. 57 refs. (LEW)

46867 **(INS—530) N=1 supergravity on the light-cone superspace.** Hori, Takayuki. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1985. 28p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703107.

The action of N=1 supergravity in the light-cone gauge is explicitly expressed in terms of an unconstrained light-cone superfield which contains the physical components of fields only. The superspace action is manifestly invariant under the kinematical supertransformations which consist of a part of the gauge preserving transformations. Our procedure is based entirely on the component formalism and the generalization to extended supergravities is straightforward.

46868 **(LA-UR—86-2386) Constraints on general SU(2)/sub L/ x SU(2)/sub R/ x U(1) electroweak models from nuclear beta decay.** Herczeg, P. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 7p. (CONF-860741—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013844.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The implications of beta-decay experiments for more general versions of SU(2)/sub L/ x SU(2)/sub R/ x U(1) models are analyzed, including the most general one which allows for CP-violation, unequal left- and right-handed quark mixing angles, and mixing in the leptonic sector. For each scenario, the constraints on the pertinent parameters from beta-decay measurements are compared with the constraints provided on them by other data.

46869 **(NIKHEF-H—85-12) On the quantization of non-compact field theories in Minkowski space.** Holten, J.W. van. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Oct 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703108.

The definition and regularization of Minkowski-space path integrals for field theories with non-compact field manifolds is examined. It is shown that a quantization procedure including constrained auxiliary field components in a positive definite Hilbert space necessarily requires non-standard analytic continuation of Green's functions for these constrained fields. 12 refs.; 3 figs.

46870 **(RRK—85-4) Supergravity theories.** Uehara, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1985. 23p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703140.

A review on the recent status of the supergravity theories is presented.

46871 **(RRK—85-6) Phase structure of the SU(3) gauge-Higgs system, 2. Adjoint Higgs.** Kikugawa, Masayoshi; Maehara, Toshinobu; Saito, Juichi; Tanaka, Hidekazu; Yamaoka, Yoshihiro; Sasaki, Ryu. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics; Hiroshima Univ. (Japan). Dept. of Physics). Feb 1985. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703109.

The phase structure of the SU(3) adjoint Higgs model is studied by a Monte Carlo simulation. We report the results of the simulation carried out on a four-dimensional euclidean lattice of size 3^4 and 6^3 x 3. We find clear signals of the transition from a symmetric phase to broken ones. At finite temperature, the broken Higgs phase consists of three parts i.e., the SU(2) x U(1)-confined phase, the U(1)-Coulomb and SU(2)-confined normal Higgs phase, and the finite temperature Higgs phase with SU(2) x U(1) Coulomb interactions. We conjecture that the last one will disappear at zero temperature. The symmetric phase is divided into two by a deconfining transition. The deconfined symmetric phase will disappear at zero temperature.

46872 **(RRK—85-7) Higher derivative regularization and chiral anomaly.** Nagahama, Yoshinori. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Feb 1985. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703110.

A higher derivative regularization which automatically leads to the consistent chiral anomaly is analyzed in detail. It explicitly breaks all the local gauge symmetry but preserves global chiral symmetry and leads to the chirally symmetric consistent anomaly. This regularization thus clarifies the physics content contained in the consistent anomaly. We also briefly comment on the application of this higher derivative regularization to massless QED.

46873 **Four-dimensional boson field theory. II. Existence.** Baker G.A. Jr. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* 27: No. 9, 2379-2393(Sep 1986). Contract W-7405-ENG-36.

The existence of the continuum, quantum field theory found by Baker and Johnson [G. A. Baker, Jr. and J. D. Johnson, J. Phys. A 18, L261 (1985)] to be nontrivial is proved rigorously. It is proved to satisfy all usual requirements of such a field theory, except rotational invariance. Currently known information is consistent with rotational invariance however. Most of the usual properties of other known Euclidean boson quantum field theories hold here, in a somewhat weakened form. Summability of the sufficiently strongly ultraviolet cutoff bare coupling constant perturbation series is proved as well as a nonzero radius of convergence for high-temperature expansions of the corresponding continuous-spin Ising model. The description of the theory by these two series methods is shown to be equivalent. The field theory is probably not asymptotically free.

46874 **Spectra of supersymmetric O(N-italic) sigma models in 0+1 dimension.** Sathiapalan, B. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Journal of Mathematical Physics (New York);* 27: No. 9, 2429-2433(Sep 1986).

The spectra of the supersymmetric O(N-italic) nonlinear sigma models in 0+1 space-time dimension are computed exactly for any N-italic, using group theoretical methods. The allowed representations are O(N-italic) analogs of the Wigner d-italic functions.

46875 **Purely cubic action for string field theory.** Horowitz, G.T.; Lykken, J.; Rohm, R.; Strominger, A. (Department of Physics, University of California, Santa Barbara, California 93106). *Physical Review Letters;* 57: No. 3, 283-286(21 Jul 1986).

We show that Witten's open—bosonic-string field-theory action and a closed-string analog can be written as a purely cubic interaction term. The conventioanl form of the action arises by expansion around particular solutions of the classical equations of motion. The explicit background dependence of the conventional action via the Becchi-Ronet-Stora-Tyutin operator is eliminated in the cubic formulation. A closed-form expression is found for the full nonlinear gauge transformation law.

46876 **Superweak C-italicP-italic nonconservation arising from an underlying quarternionic quantum dynamics.** Adler, S.L. (The Institute for Advanced Study, Princeton, New Jersey 08540). *Physical Review Letters;* 57: No. 2, 167-169(14 Jul 1986).

We show that the hypothesis of an underlying quaternionic dynamics for particle physics naturally implies an effective complex C-italicP-italic-nonconserving interaction of s-italicu-italicp-italice-italicr-italicw-italice-italica-italick-italic f-italico-italicr-italicm-italic, but arising in s-italice-italicc-italico-italicn-italicd-italic o-italicr-italicd-italice-italicr-italic in the quarternionic perturbation. The energy scale for the appearance of strong quaternionic effects is estimated to be 20 TeV.

46877 **Feeble intermediate-range forces from higher dimensions.** Bars, I.; Visser, M. (Physics Department, University of Southern California, Los Angeles, California 90089-0484). *Physical Review Letters;* 57: No. 1, 25-28(7 Jul 1986).

We develop a scenario in which feeble intermediate-range forces emerge as an effect resulting from the compactification (a-italic-grave-accent l-italica-italic Kaluza-Klein) of a five-dimensional model. It is conjectured that this general strategy will prove applicable to more realistic multidimensional theories such as the ten-dimensional superstring. We speculate that deviations from the standard gravitational force: similar to the ones reported recently as a "fifth force": may be interpreted as evidence for higher dimensions.

46878 **Quark vacuum polarization and the Luescher term.** Olsson, M.G.; Suchyta C.J. III. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* 57: No. 1, 37-39(7 Jul 1986).

The Luescher term found in the QCD string model and in Monte Carlo lattice gauge calculations is significantly modified by vacuum polarization due to light-quark loops. This modification improves agreement with experiment.

46879 **Numerical determination of the QCD β function.** Gavai, R.V.; Karsch, F. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* 57: No. 1, 40-43(7 Jul 1986). Contract AC02-76CH00016.

The β function of SU(3) lattice gauge theory with three flavors of light dynamical quarks is obtained numerically by use of the (improved) ratio method. It appears to have a dip structure similar to that found in the theory without quarks. Our data seem to sug-

gest that deviations from asymptotic scaling may be small for βapprox. >5.3.

46880 Monte Carlo calculation of the spin-dependent potentials for heavy-quark spectroscopy. Campostrini, M.; Moriarty, K.; Rebbi, C. (Istituto Nazionale di Fisica Nucleare, Sezione di Pisa, Italy and Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **57**: No. 1, 44-47(7 Jul 1986). Contract AC02-76CH00016.

We calculate by lattice numerical methods the spin-dependent potentials relevant for heavy-quark spectroscopy. We find a long-range nonperturbative component in one of the spin-orbit potentials, whereas all other potentials exhibit a short-ranged perturbative behavior.

46881 On the fermion mass and lattice size dependence of SU(2) gauge theory thermodynamics. Kogut, J.B.; Polonyi, J.; Wyld, H.W.; Shigemitsu, J.; Sinclair, D.K. (Illinois Univ., Urbana, USA. Dept. of Physics; Ohio State Univ., Columbus, USA. Dept. of Physics; Argonne National Lab., IL, USA). *Nuclear Physics B, Field Theory Statistical Systems;* **270**: No. 2, 155-168(16 Jun 1986). Contract W-31-109-ENG-38;AC02-76ER01545.

SU(2) lattice gauge theory with four Dirac fermions is studied on lattices of 2×6^3 and 4×8^3 for bare fermion masses m ranging from 1.0 to 0.10 in lattice units. The results are compared with effective field theory descriptions of the finite temperature deconfining transition. As m decreases the effective theory fails to describe the abruptness of the crossover from the hadronic to plasma phase on the 4×8^3 lattice. The 2×6^3 data are compared to the 4×8^3 data and are found to be artifically smooth and misleading. Large lattices are essential in the studies of the thermodynamics of gauge theories with fermion feedback.

46882 Equivalence of the light-cone formulation and the gauge-invariant formulation of string dynamics. Peskin, M.E.; Thorn, C.B. (Stanford Linear Accelerator Center, CA, USA; Florida Univ., Gainesville, USA. Dept. of Physics). *Nuclear Physics [Section] B;* **269**: No. 3/4, 509-529(9 Jun 1986). Contract AC03-76SF00515;AS05-81ER40008.

We show how to fix the newly discovered gauge-invariant string field theory to the light-cone gauge. We prove that this procedure leads to the well-known light-cone formulation of string field theory, with no additional propagating degrees of freedom.

46883 Testing two versions of lattice gauge theory: Creutz ratios in U-italic(1)$_3$. Cahill, K.; Reeder, R. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Journal of Statistical Physics;* **43**: No. 3, 1043-1060(Jun 1986).

In our simplicial version of lattice gauge theory, we approximate Euclidean path integrals by tiling space-time with simplexes and by linearly interpolating the fields throughout each simplex from their values at the vertices. We compare this method with Wilson's lattice gauge theory for U-italic(1) in three dimensions. As a standard of comparison, we compute the exact values of Creutz ratios of Wilson loops in the continuum theory. Monte Carlo computations using the simplicial method give Creutz ratios within a few percent of the exact values for reasonably sized loop at $\beta = 1$, 2, and 10. Similar computations using Wilson's method give ratios that typically differ from the exact values by factors of 2 or more for $1 <$ or $= \beta <$ or $= 3.5$ and that have the wrong β dependence. The better accuracy of the simplicial method is due to its use of the action and domain of integration of the exact theory, unaltered apart from the granularity of the simplicial lattice. We also present data on the action density and the mass gap.

46884 Lattice gauge theory with a fast highly parallel computer. Chist, N.H. (Department of Physics, Columbia University, New York, New York 10027). *Journal of Statistical Physics;* **43**: No. 3, 1061-1072(Jun 1986).

Results for the temperature of the color deconfinement phase transition in pure S-italicU-italic(3) lattice gauge theory are described. These were obtained on a specially built 16-node, 256 Megaflop computer using the Metropolis algorithm. The architecture, performance, and expansion plans for this machine are also discussed.

46885 β function, scaling, and improved action for S-italicU-italic(3) lattice gauge theory. Gupta, R.; Guralnik, G.; Patel, A. (Theory Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Statistical Physics;* **43**: No. 3, 1101-1104(Jun 1986).

We present a detailed analysis of the nonperturbative β function along the Wilson axis for the S-italicU-italic(3) pure gauge theory using the Monte Carlo renormalization group method. The scaling behavior of the string tension, the deconfinement transition temperature, and the 0^{++} glueball mass obtained from published data is compared. The results show that there is no asymptotic scaling for K-italic/sub F-italic/equivalent$(6/\text{g-italic}^2) < 6.1$. We also estimate the renormalized action generated by the $\sqrt{3}$ block transformation for use in future calculations.

46886 Deconfining phase transition in lattice quantum chromodynamics. Gottlieb, S.A.; Kuti, J.; Toussaint, D.; Kennedy, A.D.; Meyer, S.; Pendleton, B.J.; Sugar, R.L. (Department of Physics, University of California at San Diego, La Jolla, California 92093). *Journal of Statistical Physics;* **43**: No. 3, 1105-1116(Jun 1986).

We present a large-scale Monte Carlo calculation of the deconfining phase transition temperature in lattice quantum chromodynamics without fermions. Using the Wilson action, the transition temperature as a function of the lattice coupling g-italic is consistent with scaling behavior dictated by the perturbative β function for $6/\text{g-italic}^2 > 6.15$.

46887 Large-scale calculations for hadron spectroscopy. Rebbi, C. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Journal of Statistical Physics;* **43**: No. 3, 1117-1128(Jun 1986). Contract AC02-76CH00016.

Some recent Monte Carlo calculations for quantum chromodynamics, performed on Euclidean lattices of rather large extent, are reviewed. The purpose of the calculations is to provide accurate determinations of quantities, such as interquark potentials or mass eigenvalues, which are relevant for hadronic spectroscopy. Results obtained in quenched QCD on $16^3 \times 32$ lattices are illustrated, and a discussion of computational resources and techniques required for the calculations is presented.

46888 Lattice QCD: Going beyond the mass spectrum. Sharpe, S.R. (Physics Department, FM-15, University of Washington, Seattle, Washington 98195). *Journal of Statistical Physics;* **43**: No. 3, 1129-1146(Jun 1986).

The present status of lattice measurements with fermions is discussed. Methods are presented which improve the extraction of particle masses using staggered fermions. It is suggested that fermion physics on blocked lattices might show improvement as compared to that on lattices generated with the Wilson action. This idea is tested by comparing results from $18^3 \times 42$ lattices generated at $\beta = 6.2$ with results from the $6^3 \times 14$ lattices obtained from them by twice blocking with a 3/sup 1/2/ transformation. Also, a comparison of $8^3 \times 16$ blocked and Wilson axis lattices is made. Finally, three point correlators are used to elucidate the properties of the scalar isoscalar channel.

46889 Monte Carlo studies with the ST-100 array processor. Sugar, R.L. (Department of Physics, University of California, Santa Barbara, California 93106). *Journal of Statistical Physics;* **43**: No. 3, 1147-1170(Jun 1986).

Monte Carlo simulations with the 100 Mflop ST-100 array processor are described. The architecture of the array processor and its applicability to large-scale numerical simulations is discussed. Results are presented for the Abelian Higgs model, a charge density wave transition in a quasi-one-dimensional system and the finite temperature phase transition in S-italicU-italic(3) lattice gauge theory.

46890 Molecular dynamics algorithm for simulation of field theories in the canonical ensemble. Kogut, J.B.; Sinclair, D.K. (Illinois Univ., Urbana, USA. Dept. of Physics; Argonne National Lab., IL, USA. High Energy Physics Div.). *Nuclear Physics B, Field Theory Statistical Systems;* **270**: No. 1, 39-49(26 May 1986).

We add a single scalar degree of freedom ("demon") to the microcanonical ensemble which converts its molecular dynamics into a simulation method for the canonical ensemble (euclidean path integral) of the underlying field theory. This generalization of the microcanonical molecular dynamics algorithm simulates the field theory at fixed coupling with a completely deterministic procedure. We discuss the finite size effects of the method, the equipartition theorem and ergodicity. The method is applied to the planar model in two dimensions and SU(3) lattice gauge theory with four species of light, dynamical quarks in four dimensions. The method is much less sensitive to its discrete time step than conventional Langevin equation simulations of the canonical ensemble. The method is a straightforward generalization of a procedure introduced by S. Nose for molecular physics.

46891 Parity anomalies in gauge theories in 2+1 dimensions. Rao, S.; Yahalom, R. (Stanford Linear Accelerator Center, CA, USA; Fermi National Accelerator Lab., Batavia, IL, USA; California Inst. of Tech., Pasadena, USA). *Physics Letters [Section] B;* **172**: No. 2, 227-230(15 May 1986). Contract AC03-76SF00515.

It is shown that the introduction of massless fermions in an abelian gauge theory in 2+1 dimensions does not lead to any parity anomaly despite a non-commutativity of limits in the structure function of the odd part of the vacuum polarisation tensor. However, a parity anomaly does exist in non-abelian theories due to a conflict between gauge invariance under large gauge transformations and the parity symmetry.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 46421, 46422, 46426, 46842, 47103, 47104, 47106

46892 (BNL—38298) Review of high energy hadron-nucleus data. Lissauer, D. (Brookhaven National Lab., Upton, NY (USA). Physics Dept.; Tel Aviv Univ. (Israel). Dept. of Physics). 1986. Contract AC02-76CH00016. 21p. (CONF-860441—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014185.

From 5. international conference on ultra-relativistic nucleus-nucleus collisions (Quark Matter '86); Pacific Grove, CA, USA (13 Apr 1986).

New data on hadron-nucleus interactions are summarized, focusing on: estimation of the rate of energy loss of the incident hadron as it propagates through the target, and determining where the energy is deposited in central hadron-nucleus collisions. The present status of $pA \rightarrow p + X$ inclusive measurements is discussed. Measurements from visual detectors which allow investigation of global event properties are presented. Data taken from calorimeters, where one can trigger and measure transverse energy and energy flow over a given rapidity region, are discussed. 22 refs., 20 figs. (LEW)

46893 (DOE/ER/40048—26-N6) Fundamental interaction studies in nuclei. Haxton, W.C. (Washington Univ., Seattle (USA). Dept. of Physics). 1986. Contract AC06-81ER40048. 12p. (CONF-860575—31). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014282.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

There is a growing class of nuclear and atomic physics experiments in which the special properties of many-body systems are exploited in tests of fundamental symmetries. Three representative topics are discussed: parity nonconservation in the NN interaction, time reversal-odd nuclear moments, and matter-enhanced neutrino oscillations.

46894 (NEANDC(J)—117/U, pp 41-51) **Format of JENDL.** Nakagawa, T. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

The ENDF/B format is adopted for JENDL. In this paper, the basic aspects of the ENDF/B format are explained and differences among recent versions of the ENDF/B format are summarized.

46895 (NEANDC(J)—117/U, pp 68-98) **Processing of the nuclear data file and the problems of JENDL.** Hasegawa, A. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

A brief outline of the processing of the nuclear data files is presented. Particular stress is placed on the problems encountered in the processing of the JENDL2, JENDL-3PR1 and PR2 (Japanese Evaluated Nuclear Data File version 2, version 3 preliminary-1 and -2 files). Some recommendations to resolve the problems are also made.

46896 (NEANDC(J)—117/U, pp 99-118) **Double differential neutron emission cross sections at 14 MeV measured at OKTAVIAN.** Takahashi, A. (Osaka Univ., Yamadaoka, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

A review is given for double differential neutron emission cross sections at 14 MeV, measured at OKTAVIAN since 1981. The present status of evaluated nuclear data libraries (ENDF/B-IV and JENDL-3PR1) pertaining to fusion reactors is shown by comparison with the measured data. Results show that insufficient secondary neutron data are given in ENDF/B-IV for D, Li, Be, B C, F, Na, Cl, Ti, Cr, Mn, Ni, Cu, Zr, Nb, Mo, W and Pb, although the data for N, O, Si, Al and Fe are fairly well evaluated. Significant improvements are seen in JENDL-3PR1 & 3PR2.

46897 (NEANDC(J)—120/U) Proceedings of the 1985 seminar on nuclear data. Asami, Tetsuo; Mizumoto, Motoharu (eds.). (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jun 1986. 437p. (JAERI-M—86-080; INDC(JPN)—106/L; CONF-8511220—). JAERI, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan. File Number TI86901587.

From Seminar on nuclear data; Tokai, Japan (12 Nov 1985).

Separate abstracts were prepared for 39 papers presented in this conference. Subjects addressed at the conference included: nuclear data activities at the Institute of Atomic Energy in Beijing, China; at the research center for nuclear techniques in Bandung, Indonesia; and of the Japanese Nuclear Data Committee (JNDC). The main thrust of the conference was nuclear research in Japan including activities of the JNDC working groups, the relation between absolute and relative measurements of nuclear data, nuclear data for fusion reactors, and problems in heavy nuclide nuclear data. A poster session was held in which a large variety of topics was discussed dealing mostly with neutron research. (DWL)

6512 Nuclear Properties And Reactions, A=1-5, Theoretical

46898 (ANL—85-22, pp 9-11) **Study of the 165-MeV pion absorption mechanism in ^{3}He through the (π^+,2p) and (π^-,pn) reactions.** Ashery, D.; Geesaman, D.F.; Levenson, S.M.; Schiffer, J.P.; Stephans, G.; Ungricht, E.; Zeidman, B.; Anderson, B.D.; Das, G.; Madey, R.; McKeown, R.D. (Tel Aviv Univ., Israel). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

New measurements of the angular dependences of the ^{3}He(π^+,pp) and ^{3}He(π^-,pn) reactions were carried out to provide more quantitative information on the cross section and on the orbital angular momenta involved. The experiment was performed in the P^3 area at LAMPF with 165-MeV pions incident on a liquid ^{3}He target. Preliminary analyses indicate that the angular distribution for π^+ resembles that of the $\pi^+ + d \rightarrow pp$ reaction. The π^- angular distribution is quite similar to the π^+ distribution and is consistent with symmetry about 90°. This is in contrast to the asymmetric π^- angular distribution seen at 65 MeV. Information on the three-body absorption ($\pi^+ + {}^3He \rightarrow {}^3p$) has also been obtained. It appears that the integrated cross sections for 3-body absorption is roughly half that of the 2-body mechanism. In a second data run in the fall of 1984, the (π^+,2p) and (π^-,pn) reactions were studied at 250 MeV at proton lab angles of 20°, 40°, 75° and 130°. The 165-MeV data were also extended to the proton angle of 20°. The analysis of the data, which included significant normalization checks on the previous data is currently under way.

46899 (ANL—85-22, pp 11) **Study of the (π,πp) reaction and quasifree scattering in ^{4}He.** Ashery, D.; Geesaman, D.F.; Jackson, H.E.; Schiffer, J.P.; Zeidman, B.; Segel, R.E.; Gram, P.A.M. (Tel Aviv Univ., Israel). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The measurement of inelastic pion scattering observed in coincidence with a recoil proton has been approved for a target of ^{4}He. Angular distributions will be obtained for π^+ energies of 160, 220, and 350 MeV. Emergent pions will be detected in the LAS spectrometer while an array of scintillation counters that span a large solid angle will be used to detect protons.

46900 (ANL—85-22, pp 18) **Tensor polarization in pion-deuteron elastic scattering.** Holt, R.J.; Freeman, W.S.; Geesaman, D.F.; Specht, J.R.; Ungricht, E.; Zeidman, B.; Stephenson, E.J.; Moses, J.D.; Farkhondeh, M.; Gilad, S.; Redwine, R.P. (Fermi National Accelerator Lab., Batavia, IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

During this year the analysis of measurements of t_{20} in π-d elastic scattering was completed and a final summary manuscript was prepared for publication. The results consists of angular distributions of the deuteron tensor polarization in π-d elastic scattering at pion energies of 140, 180, 220 and 256 MeV. Theoretical calculations in which the effects of pion absorption on the elastic channel are small reproduce the data. No rapid angular or energy dependence was found near a pion energy of 134 MeV, where another experiment at SIN has suggested the existence of dibaryon resonances.

46901 (ANL—85-22, pp 43) **Search for a light-scalar boson emitted in nuclear decay.** Napolitano, J.; Freedman, S.J.; Nelson, J. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Using the Physics Division Dynamitron to produce ^{4}He (0$^+$, 20 MeV) via radiative capture of protons on a tritium target, the authors performed a sensitive search for Higgs-like scalar particles with masses roughly between 3 and 14 MeV. This work has been published. In this paper the authors point out that even though this work is more than 2 orders of magnitude more sensitive than the only previous experiment, uncertainties in the theoretical interpretation strongly suggest that a significantly more sensitive experiment be performed to lay the issue to rest.

46902 (BNL—38336) **Future dibaryon research at BNL.** Pile, P.H. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 8p. (CONF-860575—30). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014182.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

An experiment designed to search for a strangeness -1 dibaryon is discussed. The experiment will use the ^{3}He(K$^-$, π^+)nD/sub s/ reaction and is expected to begin near the end of the year at the BNL AGS using the existing LESB-I beamline and hypernuclear spectrometer system. Planned searches for a strangeness -2 dibaryon are also discussed. The strangeness -2 dibaryon searches will however require the construction of a new 1.8 GeV/c kaon beam line at the AGS.

46903 (INS—532) **Tensor analyzing power in backward pd elastic scattering and its connection to pp $\rightarrow$ πd at intermediate energies.** Nakamura, A.; Satta, L. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703146.

The tensor analyzing power for pd backward elastic scattering is calculated in the energy range 150 <= Tsub(p) <= 800 MeV. Two main contributions are considered: the one nucleon exchange and the so called triangle graph, including pp $\rightarrow$ πd as a subprocess. The pd backward elastic cross section and tensor analyzing power are fairly well reproduced by the model.

46904 (LA-UR—86-2139) **Three-body force in the three-nucleon system.** Gibson, B.F. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 16p. (CONF-8604194—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012399.

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

A brief summary of the symposium is presented. Three-nucleon force models are discussed, including the two-pion exchange potential, NN-ΔN coupled-channels model, and phenomenological parametrization. Relevant experimental data and model calculations are discussed including form factors, binding energies, charge radii, and charge density for ^{3}H and ^{3}He. A calculation of the EMC effect for ^{3}He is also made using Sasakawa's wave function and compared to experimental data obtained at SLAC. The paper ends with discussions of proton-deuteron scattering, investigations at intermediate energies, and QCD efforts to understand the three-body problem. (DWL)

46905 (UCRL—94764) **Exploratory gas-target experiment at PEP using the TPC/2 γ facility.** Dietrich, F.S.; Melnikoff, S.O.; Van Bibber, K.A. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 4p. (CONF-860575—14). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012806.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

A pilot nuclear-physics experiment at the PEP ring was performed by bleeding deuterium, argon, and xenon gases into the interaction region containing the TPC/2Y facility. The purpose of the experiment was to obtain information for the design of a dedicated nuclear-physics interaction region at PEP, as well as to obtain a first view of the physics that could be studied at such a facility. 1 ref., 4 figs.

46906 **Y-italic scaling and final state interactions in ^{3}He(e,e')x-italic.** Gurvitz, S.A.; Tjon, J.A.; Wallace, S.J. (Physics Department, Weizmann Institute of Science, Rehovot, Israel and TRIUMF, Vancouver, British Columbia, Canada V6T 2A3). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 648-653(Aug 1986).

Two theoretical approaches to y-italic scaling based on different treatments of final state interactions are compared. Experimental data show scaling in both treatments; however, there is strong disagreement between data and the West prediction based on a Faddeev momentum distribution. Partial inclusion of final state interaction by Sick, Day, and McCarthy substantially improves the comparison with data. Dramatic sensitivity to the treatment of final state interaction suggests that existing theoretical analyses are not decisive.

46907 **Radiative neutron capture by deuterium.** Mitev, G.; Colby, P.; Roberson, N.R.; Weller, H.R.; Tilley, D.R. (Duke University and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 389-400(Aug 1986).

The $^{2}H(n,\gamma)^{3}H$ reaction has been studied with polarized and unpolarized neutrons of energies ranging from 9 to 14 MeV. Angular distributions of cross section were measured at E-italic/sub n/ (lab) = 9.0, 10.8, and 14.0 MeV, $\sigma(90°)$ was measured at 6.85 MeV, and an analyzing-power angular distribution was measured at 9.0 MeV. The results for σ(t-italich-italice-italict-italica-italic) agree with the existing $^{2}H(\gamma,n)^{3}H$ data after detailed balancing. The resulting $^{3}He(\gamma,p)/^{3}H(\gamma,n)$ ratio for 90° cross sections is 1.1 +- 0.15 down to E-italic/sub x-italic/ = 10.8 MeV. The T-italic-matrix analysis of the data indicates —3% for the E-italic2 contribution to the capture cross section: comparable to that found earlier for $^{2}H(p,\gamma)^{3}He$ and in contrast to the predictions [σ/sub n/(E2)/σ/sub p/(E2) = 1/25] of a two-body direct-capture calculation.

46908 **Continuum polarization transfer in 500 MeV proton scattering and pionic collectivity in nuclei.** Rees, L.B.; Moss, J.M.; Carey, T.A.; Jones, K.W.; McClelland, J.B.; Tanaka, N.; Bacher, A.D.; Esbensen, H. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 627-636(Aug 1986).

A complete set of polarization transfer observables was measured for inclusive 500 MeV proton scattering from ^{2}H, Ca(nat.), and Pb(nat.) at t-italich-italice-italict-italica-italic/sub lab/ = 18.5° (q-italic = 1.75 fm/sup -1/). The excitation energy ranged over the entire quasielastic peak from 20 to 100 MeV. Longitudinal and transverse spin-flip probabilities were extracted from the data. These have simple model-dependent connections to the spin-longitudinal and transverse response functions for the heavy targets. Detailed analysis of the data reveals no evidence for collective enhancement in the spin-longitudinal response function. The relation of this analysis to the interpretation of the European Muon Collaboration effect in terms of excess pions is discussed in detail.

46909 **Piezonuclear fusion in isotopic hydrogen molecules.** Siclen, C.DeW.V.; Jones, S.E. (Idaho National Engineering Lab., Idaho Falls, USA). *Journal of Physics G: Nuclear Physics;* **12**: No. 3, 213-221(Mar 1986).

A rough estimate is made of the rate of fusion of the nuclei in a deuterium molecule at room temperature and atmospheric pressure. As the density of the collection of molecules is increased, the fusion rate will likewise increase, in a manner given by an easily derived semi-classical equation. With sufficient experimental data, perhaps obtained through use of a diamond-anvil high-pressure cell, density-dependent expressions for the internuclear potentials of isotopic molecular hydrogen can be constructed and values for the corresponding fusion rates calculated.

6513 Nuclear Properties And Reactions, A=6-19, Theoretical

REFER ALSO TO CITATION(S) 46852, 46923

46910 (ANL—85-22, pp 12) **Dependence of the (e,e'p) reaction in the quasifree region.** Geesaman, D.F.; Green, M.C.; Chant, N.S.; Holt, R.J.; Levenson, S.M.; Maruyama, X.K.; Redwine, R.P.; Roos, P.; Sapp, W.W.; Segel, R.E.; Schiffer, J.P. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

A proposal to study the A dependence of the (e,e'p) reaction at absolute value qvector = 540 MeV/c at the Bates electron accelerator has been approved. From the A dependence of the ratio of (e,e'p) coincidence to (e,e') singles events, the macroscopic attenuation of 140 +/- 20 MeV nucleons in nuclei will be deduced. This experiment will be the first experiment at BATES to use the BIGBITE spectrometer. During three shakedown runs in 1984 the spectrometer was brought on-line with a preliminary detector stack. A gas Cerenkov counter is being constructed at Argonne for electron identification in the OHIPS spectrometer. In 1985, the final spectrometer tests will be completed and beam time will be scheduled for the experiment.

46911 (ANL—85-22, pp 13) **Study of the (p,π^-) reaction very close to threshold.** Jacobs, W.W.; Green, M.C.; Brown, J.; Emery, G.T.; Throwe, T.G.; Vigdor, S.E. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have studied the energy dependence of the differential cross section and analyzing powers of the $^{13}C(p,\pi^-)$ ^{14}O/sub gs/ reaction for outgoing pion energies of 5-20 MeV. The measurements have been performed at the Indiana University Cyclotron Facility. Most recently the authors have completed measurements for incident proton kinetic energies of 157 and 171 MeV. From this and previous data at 183 and 190 MeV, total cross sections and the s-wave amplitudes have exhibited an energy dependence consistent with that expected from a simple Coulombic interaction of the π^- with the residual nucleus. The p-wave amplitudes show this energy dependence except at 171 MeV where the p-wave amplitude for the incoming proton and target nucleus spins aligned shows a three standard deviation enhancement.

46912 (ANL—85-22, pp 22) **Inelastic scattering of pions by ^{10}B and ^{11}B.** Zeidman, B.; Geesaman, D.F.; Olmer, C.; Morrison, G.C.; Burleson, G.R.; Greene, J.S.; Morris, C.L.; Boudrie, R.L.; Segel, R.E.; Swenson, L.W.; Blanpied, G.S. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The EPICS spectrometer at LAMPF was used in a study of elastic and inelastic scattering of π^+ and π^- by targets of ^{10}B and ^{11}B at T/sub π/ = 162 MeV. Angular distributions between 20° and 90° were measured in 5° steps for π^+ and π^-. In addition, spectra were obtained at 3 angles each at T/sub π/ = 130 and 250 MeV, namely angles corresponding to momentum transfers where the differential cross sections for l = 2, 3, and 4 are maximized. Among the results are evidence for a rotational band built upon $(1p/sub\ 3/2/^{-1},1d/sub\ 5/2/)_4$ - neutron particle-hole configurations. A number of states strongly excited at high excitation energy, are compared with theoretical shell-model predictions.

46913 (ANL—85-22, pp 38) **Beta decay of polarized nuclei and the decay asymmetry of ^{8}Li.** Bigelow, R.; Freedman, S.J.; Napolitano, J.; Quin, P.A. (Univ. of Wisconsin, Madison). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Under certain conditions, it is possible to produce vector-polarized radioactive nuclei in reactions with a polarized projectile and an unpolarized target. Using the intense polarized beams at the University of Wisconsin, the authors have begun a program to study the weak interaction through the beta decay of polarized nuclei produced in this way. Such experiments bear on tests of CVC in light nuclei, sensitive searches for second-class weak currents, and measurements of the weak vector-coupling constant. One may also deduce the values of certain matrix elements. Our effort is presently centering on a study of the energy dependence of the beta-decay asymmetry of ^{8}Li.

46914 (ANL—85-22, pp 39-40) **Proposed new measurement of the ^{10}C superallowed beta decay.** Freedman, S.J.; Holzmann, R.; Kroupa, M.; Lesko, K.; Napolitano, J.; Nelson, J. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

To determine the Cabibbo angle the authors have proposed studying the decay $^{10}C \rightarrow {}^{10}B + e^+ + nu$. Since the dominant error in the ft-value in this system is in the partial lifetime, the authors intend to improve their knowledge of the $O^+ \rightarrow O^+$ branching ratio. Since the two major decay branches lead to excited states in ^{10}B, the branching ratio corresponds to the relative intensity of 718-keV and 1022-keV gamma rays. The authors will produce ^{10}C and measure the relative yield of the two gamma-rays from the β-decay, and then measure the relative gamma-ray efficiencies in a concurrent particle-gamma coincidence experiment. In a series of preliminary runs in August 1984 the authors checked the feasibility of these measurements. The authors observed the deexcitation gamma-rays of the excited states in ^{10}B in coincidence with their respective recoil protons, as a test of the efficiency calibration. The authors also observed the 718-keV gamma-ray from the β-decay. Unfortunately, the low beam current for this series of tests did not allow them to observe the 1022-keV gamma ray from the desired decay branch.

46915 (ANL—85-22, pp 40) **Measurement of a large B(E2) in ^{10}B.** Nelson, J.; Napolitano, J.; Freedman, S.J. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

It has been known for some time that the E2 transition strength from the 4.77-MeV, 3^+ level in ^{10}B to the 0.72-MeV, 1^+ level was measured to be much larger than one would expect in light nuclei. Kurath has shown that a large enhancement may be expected due to collective effects. However, the experimental value was still nearly three times larger than could be easily accommodated. Using the Physics Division Dynamitron, the authors remeasured this quantity using radiative capture of alpha particles on an evaporation-in-situ ^{6}Li target. Photons of 720 keV were detected using a Ge(Li) spectrometer. The detection efficiency was determined using the well-studied radiative-capture process to the 5.16-MeV state in ^{10}B. The authors find that for the $4.77 \rightarrow 0.72$-MeV transition, $B(E2) = 21 +/- 2\ e^2fm^4$ whereas Kurath predicts approximately $13e^2fm^4$.

46916 (ANL—85-22, pp 65) **Fusion cross section behavior for ^{10}B + ^{13}C and ^{11}B + ^{12}C.** Mateja, J.F.; Garmon, J.A.; Fields, D.E.; Frawley, A.D.; Kovar, D.G.; Henderson, D.; Ikezoe, H.; Janssens, R.V.F.; Lesko, K.T.; Rosner, G.; Stephens, G.S.F. (Tennessee Technical University, Cookeville). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Time-of-flight measurements for the ^{11}B + ^{12}C system were performed for comparison with results obtained last year for the ^{10}B + ^{13}C system. By studying the total fusion cross section behavior for two different entrance channels which form the same compound nucleus (i.e., ^{23}Na) one hopes to understand whether the observed cross section energy dependence ($4 <$ E/sub Lab/ < 9 MeV/nucleon) is generated by limitations imposed by the compound nucleus or by entrance channel effects. The results of our measurements showed that the observed cross section behaviors for the two entrance channels were not consistent with a fusion limitation produced solely by the properties of the compound nucleus (i.e., by reaching of a critical density of compound nucleus states), and that the cross section behavior appears to be governed by entrance-channel limitations. At the highest energy measured the critical angular momenta for fusion extracted for the two systems were found to have merged to become (within the error bars) the same which suggests that at high bombarding energies a similar critical angular momenta might exist for the two entrance channels.

46917 (ANL—85-22, pp 68) **Projectile-target dependence of incomplete fusion processes.** Kovar, D.G.; Rosner, G.; Janssens, R.V.F.; Henderson, D.; Ikezoe, H.; Kolata, J.J.; Stephans, G.S.F.; Lesko, K.T.; Ungricht, E.; Wilkins, B.; Prosser, F.W. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The results of recent heavy-ion studies indicate that at higher bombarding energies not all central collisions result in the fusion of the projectile and target, but rather that an increasing fraction of these collisions involve the emission of a particle or particles from the projectile or target prior to fusion (i.e., incomplete fusion processes). To obtain information regarding the projectile-target dependence of complete and incomplete fusion processes, measurements of the velocity spectra of the evaporation residues from fusion reactions have been performed using beams of ^{16}O, ^{24}Mg, ^{28}Si, ^{32}S on a series of light- and medium-weight target nuclei. Deviations of the spectra constitute evidence for contributions from incomplete fusion processes and provide an indication of their magnitude. The analysis of these measurements have been completed, revealing evidence that for asymmetric systems (i.e., A/sub proj./ $<$ A/sub targ./ and A/sub proj./ $>$ A/sub targ./) incomplete fusion processes begin to contribute above some threshold velocity, contributing as much as 30% of the ER yields at the highest energy studied (E/sub Lab/ = 9 MeV/nucleon).

46918 (ANL—85-22, pp 70-71) **Evaporation-residue-velocity measurements for fusion of ^{14}N with light target nuclei.** Stephans, G.S.F.; Kovar, D.G.; Janssens, R.V.F.; Ikezoe, H.; Rosner, G.; Lesko, K.T.; Kolata, J.J.; Wilkins, B.; Gonthier, P.L.; de Toledo, A.S.; Szanto, E. Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

There is strong evidence from investigations of incomplete momentum transfer that these processes involve the emission of high-energy light fragments, especially α particles, before fusion occurs. The ^{14}N measurements were performed to investigate the influence of nuclear structure in the onset of incomplete momentum-transfer reactions and to establish its energy dependence. Effort this year was spent in analysis of data obtained in TOF measurements of evaporation residues (ER) in ^{14}N-induced reactions on targets ranging in mass $12 <$ A/sub target/ < 48 at beam energies of 5.5, 7.0, and 9.2 MeV/nucleon at ANL and 15, 25, and 35 MeV/nucleon at MSU. In addition, a fusion angular distribution was measured for ^{14}N + ^{40}Ca at 9.2 MeV/nucleon at ANL in order to obtain the fusion cross-section. A TOF system including two channel plates and a Si dE-E telescope was used to produce precise velocity measurements and also allow detection of high-energy light particles. The analysis of the ER velocity spectra revealed that the fraction of the beam momentum transferred to the compound system is roughly 100% at 5.5 MeV/nucleon, 92% at 15 MeV/nucleon, 72% at 25 MeV/nucleon, and 64% at 35 MeV/nucleon.

46919 **(INIS-mf—10409) Transverse excitations of ^{19}F.** Donne, A.J.H. (Vrije Univ., Amsterdam (Netherlands)). 25 Sep 1985. 136p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703150.

In this thesis aspects of the structure of the nucleus ^{19}F are discussed as a result of transverse electron-scattering experiments, with emphasis on the ground state. The magnetization distribution of this state has been obtained from the measurement of electrons scattered from ^{19}F at backward angles. An introduction to the electron-scattering formalism is presented briefly together with the interpretation of electron-scattering results in terms of the nuclear shell model. The experimental apparatus for the measurement of electron scattering through an angle of 180^0 is described. This instrumentation has been installed in the low-energy facility (LEF) at NIKHEF-K. Simultaneously with the study of the magnetic ground state distribution of ^{19}F, excited states of this nucleus up to an energy of 4.4 MeV have also been investigated, mainly from data obtained in the EMIN station. Also for these states, the shell-model calculations have been the guide to determine their structure. Includes Dutch summary; 126 refs.; 51 figs.; 10 tabs.

46920 (NEANDC(J)—117/U, pp 32-40) **Revision of the neutron nuclear data of lithium.** Chiba, S. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Neutron nuclear data of ^{6}Li and ^{7}Li stored in JENDL-3PR1 were revised, mainly on the basis of the double differential cross sections measured at Osaka and Tohoku Universities. Results of the analyses of some integral experiments were also taken into consideration. The present revision was restricted to the neutron emitting reactions. The revised data reproduce well the measured double differential cross sections.

46921 (NEANDC(J)—117/U, pp 119-140) **Measurements of double-differential neutron emission cross sections at Tohoku University.** Baba, M. (Tohoku Univ., Aramaki-Aoba, Sendai, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

A brief summary is presented for measurements and analyses of double-differential neutron emission cross sections for fusion reactor materials performed at the Tohoku University Dynamitron facility. The experiments and the typical results are described for / sup 6,7/Li, ^{9}Be, C, O, Fe, Ni and Pb. The experimental results for emission spectra and scattering cross sections are discussed in comparison with JENDL-3PR1.

46922 (NEANDC(J)—117/U, pp 141-148) **Nuclear data testing on integral experiments of lithium spheres.** Sugiyama, K.; Yamamoto, J.; Iguchi, T. (Tohoku Univ., Aramaki-Aoba, Sendai, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Uncertainty on the neutron nuclear data of lithium isotopes is discussed concerned with integral experiments using two kinds of lithium spheres, 40 cm and 120 cm in diameter. Experimental results of neutron leakage spectra and tritium production rates indicate that the cross section of ^{7}Li(n,n'α)T in the data file JENDL-3 PR2 is preferred in comparison with the values in ENDF/B-IV, and there are some discrepancies for the (n,2n) cross sections of lithium in both files.

46923 (NEANDC(J)—117/U, pp 160-170) **Comparison between measurements of the neutron spectra from materials used in fusion reactors and calculations using JENDL-3PR1.** Hashikura, H.; Oka, Y.; Kondo, S. (Univ. of Tokyo, Tokai-mura, Naka-gun, Ibaraki, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

JENDL-3PR1 which includes very important nuclides for analysis of fusion blanket experiments has been already released. The accuracy of the nuclear data has been checked by the comparison of the integral measurements with the calculational results using JENDL-3PR1. Several problems are pointed out.

46924 (NEANDC(J)—117/U, pp 171-182) **Clean benchmark experiments and analyses at FNS.** Maekawa, H. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Two types of clean benchmark experiments have been carried out at the FNS (Fusion Neutronics Source) facility. They are integral experiments and time-of-flight experiments. The former includes integral experiments on cylindrical assemblies with: (1) 60-cm thick lithium oxide (Li_2O), (2) 60-cm thick graphite, and (3) 40-cm thick Li_2O followed by 20-cm thick graphite. Various reaction rates such as tritium production rate and neutron spectra were measured in these experiments. The time-of-flight experiments were conducted to measure angle-dependent neutron spectra leaking from: (1) Li_2O, (2) graphite, and (3) lithium-metal slab assemblies. These experiments were numerically analyzed by making use of the DOT3.5 transport code with newly processed 125-group cross-section sets, i.e., JENDL-3PR1, JENDL-3PR2, ENDF/B-IV, and ENDF/B-V (^{12}C only). It was found that the calculations based on JENDL-3PR1 and JENDL-3PR2 predicted tritium production rates of ^{6}Li and ^{7}Li better than those based on ENDF/B-IV. These analytical results are expected to provide useful information for the future development of the JENDL-3 nuclear data file.

46925 **Spin dependence of the isospin-forbidden decay ^{8}Be(E-italic/sub x-italic/ = 27.5 MeV)→d+^{6}Li.** Soderstrum, J.P.; Knutson, L.D. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 401-407(Aug 1986).

The first T-italic = 2 state in ^{8}Be (E-italic/sub x-italic/ = 27.483 MeV) has been studied by means of the isospin-forbidden resonance in the reaction d+ ^{6}Li→α+α. Angular distributions of the cross section and of the four analyzing powers for the reaction ^{6}Li(d-arrow-right,α) ^{4}He have been measured at energies above, below, and on resonance. Off-resonance analyzing power measurements have also been obtained for ^{2}H(^{6}Li-arrow-right,α) ^{4}He. Because of the symmetry properties of the reaction, the number of independent collision matrix elements is fairly small, and this makes it possible to determine the matrix elements directly by fitting the data. By comparing the matrix elements, one can determine partial widths (Γ_0 and Γ_2) for decay of the ^{8}Be state into d+ ^{6}Li states with channel spin 0 and 2. The measured ratio of the partial widths is $\Gamma_2/\Gamma_0 = 0.322 +- 0.091$.

46926 **Radiative pion capture on /sup 13/C.** Singham, M.K.; Tabakin, F. (Theoretical and Medium Energy Physics Divisions, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 637-642(Aug 1986).

It is found that the differential cross sections for /sup 13/ C(π^+,γ)/sup 13/N /sub g.s./ for 115.5 MeV kinetic energy pions can be understood within the framework of a distorted wave impulse approximation, suggesting that core polarization and precursor effects give small contributions. It is further found that, within the limits of current nuclear photopion theory, the data for the radiative capture process are incompatible with earlier measurements for the inverse reaction /sup 13/C(γ,π^-)/sup 13/N /sub g.s./. It is shown that the reconciliation of the two sets of data places stringent demands on possible modifications to the theory.

6514 Nuclear Properties And Reactions, A=20-38, Theoretical

46927 (ANL—85-22, pp 26) **Polarized proton scattering from ^{26}Mg.** Geesaman, D.F.; Zeidman, B.; Olmer, C.; Bacher, A.D.; Emergy, G.T.; Glover, C.W.; Nann, H.; Jones, W.P.; van der Werf, S.Y.; Segel, R.E.; Lindgren, R.A. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have measured the angular distributions and analyzing powers for polarized proton scattering from ^{26}Mg at 135-MeV incident energy at the Indiana University Cyclotron Facility. Angular distributions were measured in 5° steps from a laboratory angle of 10° to 60° for states in the excitation energy range from 0 to 20 MeV. Five 6$^-$ states have been identified based on the charac-

teristic angular distributions of the cross sections and analyzing powers at 9.17-, 11.98-, 12.48-, 12.85- and 18.05-MeV excitation energy.

46928 (ANL—85-22, pp 27) **Transverse electron scattering by ^{26}Mg.** Geesaman, D.F.; Hicks, R.S.; Huffman, R.L.; Lindgren, R.A.; Maruyama, X.K.; Olmer, C.; Plum, M.A.; Wildenthal, B.H. (Indiana Univ., Bloomington). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The inelastic scattering of electrons by ^{26}Mg was studied using the 180° inelastic-electron-scattering facility at the Bates Linear Accelerator Laboratory. Measurements were made at incident energies of 140, 163, 193 and 212 MeV to map the first peak of the form factors for M6 transitions. Five 6^- states were identified at 9.12, 12.49, 12.91, 14.41, and 18.06 MeV excitation. The 18.06-MeV state was identified as a T = 2, 6^- level.

46929 (ANL—85-22, pp 69) **Time-of-flight measurements of evaporation residues from ^{32}S + ^{24}Mg.** Kolata, J.J.; Hinnefeld, J.; Kovar, D.G.; Janssens, R.V.F.; Lesko, K.T.; Stephans, G.S.F.; Rosner, G.; Wilkins, B.; Henderson, D.; Gonthier, P.L.; Prosser, F.W. (Univ. of Notre Dame, South Bend, IN). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

As a further investigation of the mass-asymmetry dependence of this reaction, the system ^{32}S + ^{24}Mg which forms the same compound nucleus was studied. A time-of-flight detector system was used to measure the angular distributions and the velocity spectra for individually resolved evaporation residue masses in reactions induced at E/sub lab/ (^{32}S) = 290, 250, and 200 MeV. The velocity spectra were found to be consistent, within the uncertainties of the measurements, with those expected for complete fusion at all three bombarding energies. The preliminary values for the total ER cross sections extracted are found to fall intermediate between those observed for ^{16}O + ^{40}Ca and ^{28}Si + ^{28}Si. Comparison with model calculations are presently underway.

46930 **/sup 36,38/Ar(d-bar,α)/sup 34,36/Cl reactions induced by tensor polarized deuterons.** Bhat, C.M.; Tagishi, Y.; Ludwig, E.J.; Brown, B.A. (University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514 and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 736-739(Aug 1986).

Exact finite-range distorted-wave Born approximation analyses of cross section and vector and tensor analyzing power angular distributions for some /sup 36,38/Ar(d-arrow-right,α) transitions induced by 16 MeV polarized deuterons have been performed using full s-italicd-italic-shell model wave functions and including a D-italic-state amplitude for the α particle. The L-italic-mixing ratios R-italic for several unnatural parity transitions have been determined from comparisons of the calculations with the tensor analyzing power data. Shell-model calculations are found to be in agreement with the experimentally obtained phases of R-italic, while the predicted magnitudes agree well in some cases.

46931 **Analyzing power of /sup 27/Al(n-arrow-right,n-arrow-right$_0$) at 14 and 17 MeV and the isospin dependence of the optical model potential.** Martin, P.; Walter, R.L. (Department of Physics, Duke University, Durham, North Carolina 27706 and Triangle Universities Nuclear Laboratory, Durham, North Carolina 27706). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 384-388(Aug 1986).

The analyzing powers of 14 and 17 MeV neutrons elastically scattered from /sup 27/Al have been measured. Two spherical optical model analyses of these and previously published data have been performed. The first one, which concentrated only on neutron cross section data at 14 and 17 MeV and the new analyzing powers, led to a new set of spherical optical model parameters, including a spin-orbit strength and a diffuseness of about 5.6 MeV and 0.36 fm, respectively. The second incorporated cross section and analyzing power data for proton scattering at slightly higher energies, to compensate for Coulomb energy differences. The data were successfully described with a set of parameters which included isospin-dependent potentials with isospin parameters V-italic$_1$/sub R-italic/ = 22.4 MeV and W-italic$_1$/sub D-italic/ = 15.7 MeV.

46932 **Entrance channel limit on the fusion of /sup 28/Si with /sup 12/C at high energy.** Harmon, B.A.; Thornton, S.T.; Shapira, D.; Gomez del Campo, J.; Beckerman, M. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 552-561(Aug 1986).

Cross sections for the fusion of /sup 28/Si+/sup 12/C have been measured at center of mass bombarding energies of 39, 43.5, 48, and 54 MeV. Velocity and energy spectra of reaction products having charge Z-italic> or =12 and mass number A-italic> or =24 were studied at several angles between t-italich-italice-italict-italica-italic/sub lab/ = 2° and 13°. Separation of fusion from other processes was made by comparison of kinematic calculations to measured spectra. The extracted critical angular momentum (l-italic/sub cr//sup fus/) of 22h-dash-bar indicates the existence of an entrance-channel-imposed limit on the high energy fusion cross section. More symmetric systems forming the same compound nucleus, /sup 40/Ca, have considerably larger limiting angular momenta. This result is consistent with the previous observation of a maximum angular momentum of 22h-dash-bar (relative to the entrance channel) for the orbiting dinuclear complex found in studies of back-angle deeply inelastic scattering of /sup 28/Si and /sup 12/C.

6515 Nuclear Properties And Reactions, A=39-58, Theoretical

46933 (ANL—85-22, pp 23) **Excitation of 8^-, particle-hole states in ^{54}Fe.** Geesaman, D.F.; Lawson, R.D.; Olmer, C.; Bacher, A.D.; Boudrie, R.L.; Morris, C.L.; Lindgren, R.A.; Burleson, G.R.; Greene, S.J.; Cottingame, W.B.; Segel, R.E. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The scattering of π^+ and π^- by ^{54}Fe was studied at T/sub π/ = 162 MeV utilizing the EPICS system at LAMPF. Particular interest was placed upon the excitation of 8^- states that result from particle-hole configurations of the form (1f/sub 7/2/$^{-1}$,1g/sub 9/2/)$_{8^-}$. In an analysis of the pion and electron scattering data, the isoscalar and isovector amplitudes were extracted for each 8^- state. The summed isoscalar strength was 11% of the one-particle 3-hole limit while 38% of the isovector strength was observed.

46934 (ANL—85-22, pp 24) **Isoscalar quenching in the excitation of 8^- states in ^{52}Cr.** Geesaman, D.F.; Zeidman, B.; Morrison, G.C.; Boudrie, R.L.; Morris, C.L.; Burleson, G.R.; Greene, S.J.; Swenson, L.W. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The EPICS system at LAMPF has been used in an investigation of the properties of 8^- states in ^{52}Cr excited by the scattering of 162-MeV π^+ and π^-. The experiment is directed toward answering a fundamental question concerning quenching in inelastic scattering. Preliminary analysis of the data indicates that the yrast 8^- state is predominantly a neutron particle-hole excitation and is observed at an excitation energy of ~8 MeV, somewhat lower than anticipated.

46935 (ANL—85-22, pp 25) **Excitation of 8^- states in ^{52}Cr.** Zeidman, B.; Geesaman, D.; Karbon, O.; Morrison, G.C.; Fagg, L.W.; Sober, D.I.; Maruyama, X.K.; Lindgren, R.A.; deVries, H.; van Hienen, J.F.K. (Univ. of Birmingham, England). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The 8⁻ states formed by particle-hole excitations involving (1g/sub 9/2/,1f/sub 7/2/⁻)₈√ configurations in ⁵⁸Cr have been studied by scattering electrons with kinetic energies ranging from 170 MeV to 260 MeV at NIKHEF, Amsterdam. In addition to the T = 3 state at ~15.47 MeV excitation, T = 2 states have been observed at energies ranging from 8- to 12-MeV excitation.

46936 (ANL—85-22, pp 54) **Inelastic scattering and single-nucleon transfer reactions induced by ^{16}O on ^{40}Ca.** Stephans, G.S.F.; Kovar, D.G.; Henning, W.; Kolata, J.J.; Rehm, K.E.; Rosner, G.; Ikezoe, H.; Parko, R.; Vojtech, R. Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Effort has been spent in the analysis of results obtained at ANL in measurements of elastic and inelastic-scattering, and single-nucleon transfer reactions observed in ^{16}O + ^{40}Ca at E/sub lab/ = 150 MeV. The energy resolutions of 150 keV obtained in the measurements using the split-pole magnetic spectrograph make possible the investigation of transitions to resolved states in the final nuclei. Finite-range DWBA calculations were successful in reproducing the strength of all single-nucleon pick-up and stripping reactions leaving one of the two nuclei in its ground state. By contrast, similar calculations failed to reproduce the strength of ^{16}O-induced transfer reactions on ^{208}Pb at similar energies above the Coulomb barrier. DWBA predictions of the shape of the ^{16}O + ^{50}Ca transfer angular distributions, which are forward peaked, were only fair. CCBA calculations have been performed for the 150-MeV ^{16}O + ^{40}Ca elastic and inelastic data as well as for older data at lower energies (i.e., 45, 60, and 75 MeV) in order to study the energy dependence.

46937 (ANL—85-22, pp 63) **Proximity effects in deep-inelastic collisions of ^{32}S + ^{58}Ni.** Gonthier, P.L.; Hichwa, B.P.; Kovar, D.G.; Vineyard, M.F.; Stephans, G.S.F.; van den Berg, A.; Wilkins, B. (Hope College, Holland, MI). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

An experiment was performed to measure proximity effects in the deep-inelastic reactions of ^{32}S + ^{58}Ni at a projectile energy of 250 MeV. The goal of the experiment was to obtain information regarding the time scales of the dissipation of energy and transfer of nucleons between deep-inelastic products. The deep-inelastic fragments were detected in two Si detector dE-E telescopes, positioned at +/- 40 degrees, which determined the fragments energy and nuclear charge Z. The energy spectra and angular correlation of light-particles in coincidence with the deep-inelastic fragments were measured in eight Si dE-E telescopes positioned at forward and backward angles. Analysis of the results is in progress at this time.

46938 (ANL—85-22, pp 66) **Fusion evaporation residues and the distribution of reaction strength in ^{16}O + ^{40}Ca and ^{28}Si + ^{28}Si reactions.** Kolata, J.J.; Hinnefeld, J.; Kovar, D.G.; Vineyard, M.F.; Henderson, D.; Janssens, R.V.F.; Lesko, K.T.; Menchaca-Rocha, A.; Prosser, F.W.; Sanders, S.J.; Stephans, G.S.F. (Univ. of Notre Dame, South Bend, IN). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

In measurements performed previously at ANL, studying the two entrance channels ^{16}O + ^{40}Ca and ^{28}Si + ^{28}Si which form the same compound nucleus ^{56}Ni, it was found that at higher bombarding energies (E/sub Lab/ > 5-7 MeV/nucleon) the distributions of reaction strength was dramatically different. Although the total reaction cross section behaviors for the two entrance channels are similar, the total evaporation residue (ER) cross sections for ^{28}Si + ^{28}Si decrease rapidly with increasing bombarding energies and up to the highest energy studied show no evidence for incomplete fusion processes. For ^{16}O + ^{40}Ca the ER cross section remains constant at approximately 1 barn with increasing bombarding energy and shows evidence of increasing contributions from incomplete fusion. To better understand this apparent dependence on the mass asymmetry in the entrance channel, coincidence measurements between evaporation residue-like products and heavy ions on the opposite side of the beam were performed for the two systems at E/sub Lab/ = 8 MeV/nucleon.

46939 (ANL—85-22, pp 71-72) **Coincidence measurements between evaporation residues and light particles produced in ^{16}O + ^{40}Ca and ^{28}Si + ^{40}Ca reactions.** Maguire, C.; Kui, Z.; Ma, W.C.; Robinson, S.; Watson, D.; Work, G.; Ikezoe, H.; Kovar, D.G.; Rosner, G.; Stephans, G.S.F.; Ungricht, E. (Vanderbilt Univ., Nashville, TN). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

In order to investigate the reaction mechanism responsible for the production of the evaporation residues in the reactions ^{16}O + ^{40}Ca and ^{28}Si + ^{40}Ca at bombarding energies of E/sub lab/ = 9 MeV/nucleon, coincidence measurements between the evaporation residues and light particles (M < 4) had been performed in 1983. During the current year these data were reduced and compared to model calculations. Comparison of the observed energy spectra with Monte Carlo simulation calculations revealed no evidence for pre-equilibrium emission in the case of ^{28}Si + ^{40}Ca, but evidence for a high energy component in the proton and alpha spectra observed in the ^{16}O + ^{40}Ca reaction. One estimates that as much as 30% of the evaporation residue yields produced in ^{16}O + ^{40}Ca arise from incomplete fusion processes. These observations provide additional support to a growing body of evidence that the threshold for incomplete fusion processes depends on the mass asymmetry in the entrance channel and in particular to the relative velocity of the projectile and target to the reference frame of the compound nucleus, and that the mechanism for incomplete fusion may be associated with the Fermi motion of the individual nucleons in the interaction nuclei.

46940 **(ORNL/TM—9964) Update of ENDF/B-V Mod 3 iron: neutron-producing reaction cross sections and energy-angle correlations.** Fu, C.Y.; Hetrick, D.M. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 25p. (ENDF—341). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014340.

An update of the ENDF/B-V Mod-3 evaluation for natural iron is described. The cross sections of (n,n') and (n,2n) reactions are revised. Energy-angle correlations in the secondary (n,n') neutrons are introduced in the ENDF/B-V formats. Anisotropic angular distributions are provided for the secondary neutrons in (n,2n), (n,np), and (n,nα) reactions. Revelant integral results, microscopic data, and nuclear model calculations that influence the revised results are summarized. 54 refs., 9 figs., 2 tabs.

46941 **Elastic scattering of 65 MeV positive and negative pions from nickel isotopes.** Fick, B.; Blecher, M.; Gotow, K.; Wright, D.; Boudrie, R.L.; Burman, R.L.; Mack, D.; Ritchie, B.G.; Roos, P.G.; Escalante, J.A.; Mishra, C.S.; Preedom, B.M.; Whisnant, C.S. (Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 643-647(Aug 1986).

Angular distributions of elastic differential cross sections were obtained at 65 MeV using positive and negative pions scattered from /sup 58/Ni, /sup 60/Ni, and /sup 64/Ni. The data were compared to predictions using the Michigan State University optical potential. These predictions are not in good agreement with the data. The negative pion cross sections are more poorly described than the positive pion cross sections. The p-italic-wave part of the potential is observed to be especially sensitive to this Coulomb-nuclear interference effect.

46942 **Nuclear collective flow as a function of projectile energy and mass.** Doss, K.G.R.; Gustafsson, H...; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Ritter, H.G.; Schmidt, H.R.; Wieman, H. (Gesellschaft fuer Schwerionenforschung, D-6100 Darmstadt, West Germany and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* 57: No. 3, 302-305(21 Jul 1986).

The dependence of collective nuclear flow on multiplicity and beam energy for Ca + Ca, Nb + Nb, and Au + Au collisions has been measured with the Plastic Ball detector at the Bevalac. Event by event the data are analyzed with the transverse-momentum method and a new quantitative measure of the flow effect is extracted. It is expected that comparison of the present systematic results with model calculations will lead to a more precise determination of the nuclear-matter equation of state.

46943 **Reaction /sup 58/Ni(πi,2p-italic) at 160 MeV.** Burger, W.J.; Beise, E.; Gilad, S.; Redwine, a.R.P.; Roos, P.G.; Chant, N.S.; Breuer, H.; Ciangaru, G.; Silk, J.D.; Blanpied, G.S.; Preedom, B.M.; Ritchie, B.G.; Blecher, M.; Gotow, K.; Lee, D.M.; Ziock, H. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* 57: No. 1, 58-61(7 Jul 1986).

Data for the /sup 58/Ni(π^+,2p-italic) reaction at T-italicπ = 160 MeV were obtained for a number of angle pairs. The resultant angular correlations for T-italic$_1$+T$_2$>160 MeV (guaranteed pion absorption) peak at a separation angle corresponding to absorption on a deuteron at rest. However, simple estimates of initial- and final-state scatterings suggest that less than 50% of the absorption cross section arises from absorption on nucleon pairs. The data show little evidence for scattering of pions before absorption on nucleon pairs.

6516 Nuclear Properties And Reactions, A=59-89, Theoretical

46944 (ANL—85-22, pp 52-53) **Study of transfer processes in the systems ^{58}Ni + ^{58}Ni and ^{58}Ni + ^{64}Ni at energies in the vicinity of the barrier.** Rehm, K.E.; van den Berg, A.; Henning, W.; Wolfs, F.L.H. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

For the systems ^{58}Ni + ^{58}Ni and ^{58}Ni + ^{64}Ni large differences in the subbarrier fusion cross sections have been observed, which were attributed in some theoretical models to the coupling of 2-neutron transfer channels with positive Q-values. The authors have measured the magnitude and the energy dependence of transfer reactions at energies in the vicinity of the barrier. The particle identification was performed with the magnetic spectrograph utilizing the new parallel plate timing detector for mass identification. The transfer processes are dominated by the one-neutron transfer reactions (^{58}Ni, ^{59}Ni) while the cross section for two-neutron transfer (^{58}Ni, ^{60}Ni) is smaller by about a factor of 3.4. The average effective Q-value for these reactions is about -1 MeV.

46945 (ANL—85-22, pp 79) **Fusion of ^{78}Se + ^{78}Se and ^{82}Se + ^{82}Se.** Janssens, R.V.F.; Khoo, T.L.; Henning, W.; Kuehn, W.; Lesko, K.T.; Radford, D.C.; Ronningen, R.M.; van den Berg, A. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

These measurements are part of a series directed towards understanding the suppression of neutron emission observed in fusion of ^{64}Ni + ^{92}Zr → ^{156}Er and not in fusion of ^{12}C + ^{144}Sm → ^{156}Er. The channel yields have been measured in the fusion reaction of both systems in order to extract the neutron multiplicity distributions. These will be compared with results from our earlier experiments for ^{156}Er and with published results for ^{16}O + ^{148}Nd → ^{164}Er. Data analysis is in progress.

46946 (NEANDC(J)—117/U, pp 149-159) **14 MeV integral experiment at OKTAVIAN to check differential data of secondary neutrons.** Yamamoto, J. (Osaka Univ., Yamadaoka, Suita-shi, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Differential data for Fe and Pb in ENDF/B-IV, ^{12}C in B-V and ^{7}Li in B-IV, JENDL-3PR1 and PR2 were checked with regard to secondary neutron spectra froin (n,n') and (n,2n) reactions by 14 MeV neutrons. This verification was done by making use of neutron energy spectra measured in 14 MeV integral experiments at the OKTAVIAN facility of Osaka University. In comparison with transport calculations by 1-D Sn code NITRAN, it was pointed out that there is some uncertainty in emission spectra from (n,2n) reaction with high energy threshold.

46947 **(PNL-SA—14160) Ultralow background searches for β β-decay, cold dark matter and solar axions.** Avignone, F.T.; Ahlen, S.P.; Brodzinski, R.L.; Dimopolous, S.; Drukier, A.K.; Gelmini, G.; Lynn, B.W.; Miley, H.S.; Reeves, J.H.; Spergel, D.N. (Pacific Northwest Lab., Richland, WA (USA); South Carolina Univ., Columbia (USA). Dept. of Physics; Boston Univ., MA (USA). Dept. of Physics; Stanford Univ., CA (USA). Dept. of Physics; Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (USA); Harvard Univ., Cambridge, MA (USA). Dept. of Physics). Jul 1986. Contract AC06-76RL01830. 6p. (CONF-860741—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013592.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

An ultralow background Ge detector in the Homestake gold mine is applied to searches for 0 nu $\beta\beta$-decay, cold dark matter candidates and invisible axions from the sun. A large body of low background Ge data imply <m/sub nu/> 2.3 eV. Particles with spin independent Z^0 exchange interactions and masses between 20 GeV and 5 TeV are excluded as dominant in the galactic halo. Finally, axions with F/2x'/sub e/ < 0.5 x 10^7 GeV are also ruled out. 11 refs., 3 figs.

46948 **Search for the double-β decay of /sup 76/Ge.** Avignone F.T. III; Brodzinski, R.L.; Evans J.C. Jr.; Hensley, W.K.; Miley, H.S.; Reeves, J.H. (University of South Carolina, Columbia, South Carolina 29208). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 666-677(Aug 1986).

A systematic study of the radioactive background in materials used in Ge-detector fabrication was conducted prior to the construction of an ultralow-background, 135 cm^3 prototype detector. The background from primordial radioactivities in the new system was lower by factors of between 1.5 x 10^3 and 2.5 x 10^4 when compared to commercial low-background detectors. Data were collected for 8089 h with the detector located 1438 m underground, resulting in improved lower limits for the half-lives for both two-neutrino and neutrinoless $\beta\beta$ decay of /sup 76/Ge to the ground state of /sup 76/Se and for the neutrinoless $\beta\beta$ decay to the first excited state of /sup 76/Se. The results of four recent theoretical calculations are compared in detail and used to extract limits on <m-italic/sub ν/>, the Majorana mass of ν/sub e-italic/, and on the amplitudes of the couplings of right-handed Majorana neutrinos. The best combination of the lowest background data from recent experiments results in a new limit T-italic/sub 1/2/^{0}/sup ν/approx. >3 x 10/sup 23/ yr, corresponding to <m-italic/sub ν/><2.4 eV neglecting right-handed couplings or 2.8 eV including both right-handed neutrino couplings.

6517 Nuclear Properties And Reactions, A=90-149, Theoretical

REFER ALSO TO CITATION(S) 46958

46949 (ANL—85-22, pp 55) **Quasielastic transfer strength near the barrier for ^{58}Ni + Sn.** Rehm, K.E.; van den Berg, A.; Freeman, W.S.; Henning, W.; Lee, L.L.; Lesko, K.T.; Schiffer, J.P.; Stephans, G.S.F.; Wolfs, F.L.H. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

In continuation of a program to study the interactions between /sup 58,64/Ni and the even Sn-isotopes, the authors have measured direct reaction channels at energies close to the barrier using the newly developed parallel plate timing detector in the split-pole magnetic spectrograph. Angular distributions for quasielastic neutron transfer reactions measured for the different Sn targets are shown. The integrated cross sections at E/sub lab/ = 247 MeV change from 15 mb for ^{58}Ni + ^{112}Sn to 200 mb for ^{58}Ni + ^{124}Sn. This dependence can be understood as a consequence of the underlying Q-values for the transfer reactions. Comparing these transfer cross sections with the fusion cross sections, the authors again observe that transfer reactions are the dominant processes for reactions induced by medium-weight projectiles at energies in the vicinity of the Coulomb barrier.

46950 (ANL—85-22, pp 57-58) **Quasielastic transfer for /sup 58,64/Ni induced reactions on even-A tin isotopes well above the barrier.** van den Berg, A.M.; Freeman, W.S.; Henning, W.; Lee, L.L.; Lesko, K.T.; Rehm, K.E.; Schiffer, J.P.; Stephans, G.S.F.; Wolfs, F.L.H. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The Argonne tandem-linac combination was used to study quasielastic transfer reactions induced by ^{58}Ni beams at 330 MeV and ^{64}Ni beams at 341 and 380 MeV, respectively, on the even-A / sup 112,116,120,124/Sn isotopes. Reaction products were momentum analyzed with the split-pole spectrograph and detected in a gas-filled position-sensitive focal-plane detector system. Angular distributions for elastic (+ inelastic) scattering were analyzed using the generalized Fresnel scattering model, which yields the (reduced) reaction cross section. The angular distributions for quasielastic neutron transfer reactions are bell-shaped and peak at angles roughly 10 degrees smaller than the quarter point angle for elastic scattering. The angle-integrated cross sections for one- and two-neutron pickup (stripping) reactions increases (decreases) as a function of the target mass A.

46951 (ANL—85-22, pp 59-60) **Elastic and inelastic scattering for ^{58}Ni + /sup 116,124/Sn.** van den Berg, A.M.; Freeman, W.S.; Henning, W.; Lee, L.L.; Lesko, K.T.; Rehm, K.E.; Schiffer, J.P.; Stephans, G.S.F.; Wolfs, F.L.H. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

As part of a systematic study of Ni-induced reactions the authors have measured elastic and inelastic scattering to low-lying states for the ^{58}Ni + ^{116}Sn and ^{58}Ni + ^{124}Sn systems at E/sub lab/ = 330 MeV. Thin targets (50 $^{+}$ g/cm^{2}) and the two-wire position information from the heavy-ion focal plane detector of the Enge split-pole spectrograph allowed the authors to determine a virtual focal plane where the energy resolution was ~ 1.5 MeV. The momentum spectra were analyzed using the peakfitting code AUTOFIT and fixed peak positions for the ground-state transitions and the transitions to the 2_1^+ states and their mutual excitation in the Ni- and Sn-isotopes. Results of preliminary Coupled Channel Born Approximation (CCBA) calculations for the system ^{58}Ni + ^{124}Sn are shown.

46952 (ANL—85-22, pp 61-62) **Quasielastic neutron transfer reactions on samarium isotopes.** van den Berg, A.M.; Rehm, K.E.; Kovar, D.G.; Kutschera, W.; Stephans, G.S.F. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

As part of a systematic study of quasielastic transfer reactions on medium-heavy and heavy targets using Ni beams from the Argonne LINAC, the authors studied the ^{58}Ni + Sm reaction at E/sub cm/ = 245 MeV. The targets used were /sup 144,149,150,152,154/Sm which become increasingly deformed with mass number A. The split-pole magnetic spectrograph was used to momentum analyze the reaction products which were detected in a focal-plane gas counter providing unambiguous mass and Z identification. As observed in other heavy-ion-induced transfer reactions, the angular distributions for quasielastic (Q > -30 MeV) neutron-transfer reactions peak at angles somewhat smaller than the quarter-point angle for elastic scattering and they can be fitted with a Gaussian function to extract the angle-integrated cross sections. The cross section for all ^{58}Ni-induced neutron transfer processes increases from σ/sub n/ = 148 mb for the spherical ^{144}Sm to σ/sub n/ = 224 mb for the deformed ^{154}Sm. The authors used the diffraction-model code FAST to investigate whether this increase can be attributed to Q-value and angular momentum matching or might be due to the increase in deformation for the heavier targets.

46953 (ANL—85-22, pp 73-74) **Angular momentum dependent fission barriers for /sup 170-188/pt.** Lesko, K.T.; Henning, W.; Rehm, K.E.; Rosner, G.; Schiffer, J.P.; Stephans, G.S.F.; Zeidman, B.; Freeman, W.S. Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have continued their analysis of the fusion-fission cross sections for the reactions /sup 58,64/Ni + /sup 112-124/Sn. The angular distributions of fission fragments for all systems and the angle integrated cross sections have been extracted. The fission excitation functions were added to the previously measured evaporation residue cross sections to obtain the total fusion excitation functions and, subsequently, the fission probability functions. The authors have modelled the decay of the compound nuclei /sup 170-188/Pt using the statistical decay code of Puehlhofer, CASCADE. They have succeeded in reproducing the observed fission competition for all 14 systems using a common set of input parameters for the model.

46954 (ANL—85-22, pp 75) **Limits to fusion in heavy systems.** Henning, W.; Freeman, W.S.; Lee, L.L.; Lesko, K.T.; Stephans, G.S.F. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

All attempts to produce compound nuclei with Z ≧ 110 which survive prompt fission have failed up to now. To investigate such systems the authors have started experiments to produce heavy compound nuclei in ^{42}S and ^{36}S induced reactions on targets of ^{171}Yb, ^{181}Ta, /sup 181,184/W, ^{208}Pb and ^{209}U. The measurements were performed with the use of an electrostatic deflector. The data, evaporation residue yields and delayed α particles, are presently being analyzed.

46955 (ANL—85-22, pp 77) **l-distributions in fusion of ^{64}Ni + ^{92}Zr and ^{12}C + ^{144}Sm measured with the Darmstadt-Heidelberg crystal ball.** Khoo, T.L.; Janssens, R.V.F.; Kuehn, W.; Metag, V.; Ruckelshausen, A.; Habs, D.; Groger, H.; Repnow, R.; Hlavac, S.; Simon, R.; Duchin, G. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have previously observed that in fusion of ^{64}Ni and ^{92}Zr there is a suppression of neutron emission, whereas in fusion of ^{12}C and ^{144}Sm into the same compound nucleus the observed neutron multiplicity distribution is close to that expected. Possible explanations for the suppression in terms of anomalously

energetic neutrons, unusually large gamma decay widths or an unknown yrast line have been ruled out. It has been suggested that the explanation may lie in a tail to very high l-values arising from, for instance, zero point fluctuations in the near-barrier ^{64}Ni-induced reaction. Therefore, it is germane to directly measure the l-distributions, which in addition, are of crucial interest in understanding the enhancement of sub-barrier fusion cross-sections. It is found that with 225 MeV ^{64}Ni, which is near the barrier, there is significantly larger yield at higher l-values than predicted by an empirical model due to Kailas & Gupta. This observation is consistent with an enhancement of sub-barrier fusion. In contrast, at 239 MeV, l/sub max/ ~ 37 is close to the Kailas-Gupta value. Furthermore, no tail to unexpectedly high-l values is observed, ruling out this possibility as an explanation for the neutron suppression. The l-distributions for the ^{13}C-induced reactions are rather similar to the expected empirical ones.

46956 (ANL—85-22, pp 87-88) **Lifetimes of very high spin states in ^{147}Gd.** Bjornholm, S.; Borggreen, J.; Pedersen, J.; Sletten, G.; Janssens, R.V.F.; Khoo, T.L.; Radfored, D.C. (Niels Bohr Institute, Copenhagen, Denmark). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Our first results on the spectroscopy of very high spin states in ^{147}Gd have been published recently. Shell model calculations tell us also that within a few more units of angular momentum the nucleus now has to find extraordinary ways of producing spin, either by exciting nucleons from the next major shell or by collective rotation. In an attempt to distinguish between these two modes, lifetimes and feeding times were measured by the recoil distance method. The analysis started last year is still continuing. At this stage the results can be summarized as follows: (i) Information on the lifetimes has been obtained for all states along the yrast line with spins I ≧ 75/2 and I ≦ 59/2. (ii) The measured lifetimes confirm the single particle nature of the various states (only small hindrances or enhancements with respect to the Weisskoff estimates are found).

46957 (INIS-mf—10174, pp X/51) **Gas proportional telescope used to investigate rare reactions induced by 3 MeV neutrons.** Szarka, I.; Florek, M.; Oravec, J.; Holy, K.; Helfer, H.; Jahn, U. (Komenskeho Univ., Bratislava, Czechoslovakia. Prirodovedecka Fakulta; Technische Univ., Dresden, German Democratic Republic. Sektion Physik). 1985. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703198. (CONF-8510205—Absts.).

From 3. international conference on low-level counting; Bratislava, Czechoslovakia (21 Oct 1985).

46958 (INIS-mf—10407) **Single proton transfer reactions on odd-even nuclei. Nuclear structure studies in the platinum and tin regions through stripping and pickup reactions.** Blasi, N. (Rijksuniversiteit Groningen (Netherlands)). 29 Oct 1984. 196p. NTIS (US Sales Only), PC A09/MF A01. File Number DE86703151.

This thesis is devoted to the study of one proton transfer reactions, performed with the use of the magnetic spectrograph QMG/2 of the KVI, in two regions of the mass table. Stripping and pickup reactions on the odd-A target nuclei ^{193}Ir and ^{197}Au are described in the first part. The experimental spectroscopic factors obtained are used to test several collective models that are based on coupling between bosons (phonons) and fermions. In the second part, the proton stripping reactions on ^{113}In and ^{115}In are studied. Shell model calculations are performed and applied to the experimental results. Includes Dutch summary; 130 refs.; 60 figs.; 36 tabs.

46959 **Mass of /sup 146/Gd.** Mann, L.G.; Lanier, R.G.; Struble, G.L.; Naumann, R.A.; Kouzes, R.T. (Nuclear Chemistry Division, Lawrence Livermore National Laboratory University of California, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 729-731(Aug 1986).

We have measured the Q-italic value of the /sup 148/Gd(p,t)/sup 146/Gd reaction by comparison with the /sup 65/Cu(p,t)/sup 63/Cu calibration reaction. The /sup 148/Gd target was fabricated from material produced in a Ta target. The tritons were analyzed with a quadrupole—dipole-dipole-dipole spectrometer. By combining the (p,t) Q-italic value with the /sup 148/Gd mass, we obtain -76 096 +- 6 keV for the /sup 146/Gd mass excess.

46960 **Decay of 83-min /sup 139/Ba to levels of /sup 139/La and the decay of 18-min /sup 141/Ba to levels of /sup 141/La.** Faller, S.H.; Stone, C.A.; Robertson, J.D.; Chung, C.; Aras, N.K.; Walters, W.B.; Gill, R.L.; Piotrowski, A. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 654-665(Aug 1986).

The level structures of odd proton /sup 139/La and /sup 141/La have been studied in γ-ray singles, Compton-suppressed singles, coincidence, and angular correlation experiments. No evidence was observed to support the existence of any levels in /sup 139/La in the gap between the 166-keV d-italic/sub 5/2/ level and the 1209-keV $(1/2)^+$ level, even though data were accumulated long enough to observe indirect feeding of the $(1/2)^+$ level. Additional spin and parity assignments are suggested for a number of levels in /sup 141/La based on angular correlation measurements.

46961 **Spectroscopic study of the high-spin states in /sup 135/Pr.** Semkow, T.M.; Sarantites, D.G.; Honkanen, K.; Abenante, V.; Adler, a.L.A.; Baktash, C.; Johnson, N.R.; Lee, I.Y.; Oshima, M.; Schutz, Y.; Chen, Y.S.; Saladin, J.X.; Chen, C.Y.; Dietzsch, O.; Larabee, A.J.; Riedinger, L.L.; Griffin, H.C. (Department of Chemistry, Washington University, St. Louis, Missouri 63130). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 523-535(Aug 1986).

An in-beam spectroscopic study of /sup 135/Pr was made using a 91 MeV /sup 120/Sn(/sup 19/F,4n) reaction. Two positive parity bands were observed based on the g-italic/sub 7/2/ proton orbital with $(\pi,\alpha) = (+, +- (1/2))$. A strongly populated negative parity (-,-(1/2)) band was also seen (based on the h-italic/sub 11/2/ proton orbital). The unfavored (-,+(1/2)) structure may also be present. In both the positive and negative parity bands the first backbend is attributed to the alignment of two h-italic/sub 11/2/ protons on the basis of cranked shell model calculations. The crossing frequency was found to increase in the (-,-(1/2)) band because of blocking of the h-italic/sub 11/2/ orbital. The alignment of protons in /sup 135/Pr causes a shift of γ towards $-+10^0$ with nearly collective prolate deformation. Also, there is some evidence for a second backbend and an upbend in the case of positive and negative parity bands, respectively. They could result from the alignment of the h-italic/sub 11/2/ neutrons.

46962 **Coincidence measurements of intermediate mass fragments produced in /sup 32/S-induced reactions on Ag at E-italic/A-italic = 22.5 MeV.** Fields, D.J.; Lynch, W.G.; Nayak, T.K.; Tsang, M.B.; Chitwood, C.B.; Gelbke, C.K.; Morse, R.; Wilczynski, J.; Awes, T.C.; Ferguson, R.L.; Plasil, F.; Obenshain, F.E.; Young, G.R. (National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 536-551(Aug 1986).

Single- and two-particle inclusive cross sections for the production of light nuclei and intermediate mass fragments, 3< or =Z-italic< or =24, were measured at angles well beyond the grazing angle for /sup 32/S-induced reactions on Ag at 720 MeV. Information about fragment multiplicities and reaction dynamics was extracted from measurements of light particles, intermediate mass fragments, and targetlike residues in coincidence with intermediate mass fragments. Incomplete linear momentum transfer and non-compound-particle emission are important features of collisions producing intermediate mass fragments. About half of the incident kinetic energy in these collisions is converted into internal excitation. The mean multiplicity of intermediate mass fragments is of the order of 1. Particle correlations are strongly enhanced in the plane which contains the intermediate mass fragment and the beam axis.

6518 Nuclear Properties And Reactions, A=150-189, Theoretical

46963 (ANL—85-22, pp 28-32) **High-spin, two-particle, one-hole, stretched states excited by proton induced negative pion production in nuclei.** Green, M.C.; Brown, B.A.; Brown, J.; Jacobs, W.W.; Jolivette, P.L.; Throwe, T.G.; Vigdor, S.E.; Ward, T.E. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have observed the cross section and analyzing-power distributions of 2p-1h configurations from targets of oxygen, calcium, and strontium. Each target isotope was chosen to have the highest filled neutron orbital correspond to an empty proton orbital. Respectively, the observed states are based on the configurations (1d/sub 5/2/)^3, (1f/sub 7/2/)^3, and (1g/sub 9/2/)^3 having spins as large as $13/2^+$, $19/2^-$, and $25/2^+$. From the authors' strontium measurements, they have identified previously unknown $25/2^+$ and $21/2^+$ states in ^{89}Zr. Relative cross sections for these two transitions are well reproduced by simple model calculations. The analyzing power distributions for the stretched-state transitions seem to show a yet unexplained mass-independent signature. This past fall the authors carried out measurements on samarium and lead isotopes hoping to identify high-spin states based on (1h/sub 11/2/)^3 and (1i/sub 13/2/)^3 2p-1h configurations. On-line spectra indicate some reaction cross section at the predicted excitation, though experimental energy resolution may prevent identification of particular states. Off-line data analysis is currently under way at IUCF.

46964 (ANL—85-22, pp 75) **Evaporation residue cross-sections in fusion of ^{64}Ni + ^{92}Zr and ^{12}C + ^{144}Sm.** Janssens, R.V.F.; Holzmann, R.; Henning, W.; Khoo, T.L.; Lesko, K.T.; Stephans, G.S.F.; Radford, D.C.; van den Berg, A. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

As part of a series of measurements to understand the origin of neutron suppression in ^{64}Ni + ^{92}Zr fusion, the authors have measured the evaporation residue cross-sections. These measurements have also a direct bearing on the problem of enhanced sub-barrier fusion. Residue cross-section in fusion of ^{64}Ni + ^{92}Zr and ^{12}C + ^{144}Sm have been measured over a wide range of bombarding energies, including those below the Coulomb barrier. Using a technique previously developed here at ANL, the residues were separated from the beam by electrostatic deflection and detected at 4 angles including 0°. Analysis of the data is nearing completion.

46965 (ANL—85-22, pp 80-81) **Feeding times of high spin states in /sup 152,154/Dy: probes of nuclear structure above the yrast line.** Khoo, T.L.; Chowdhury, P.; Frekers, D.; Janssens, R.V.F.; Azgui, F.; Emling, H.; Grosse, E.; Michel, C.; Simon, R.S.; Spreng, W.; Wollersheim, H.J. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Measurements of feeding times of high spin yrast states up to spin 30 h in ^{154}Dy and 36 h in ^{152}Dy were utilized to obtain information about possible spin dependent shape changes. The reactions ^{26}Mg (^{134}Xe,5n), ^{124}Sn (^{34}S,4n) and ^{26}Mg (^{132}Xe,5n) ^{122}Sn, (^{34}S,4n) were used to populate the high spin states in ^{154}Dy and ^{152}Dy, respectively. The experiments with sulfur beams were conducted at ANL, while those with Xe were performed at GSI. Feeding times as well as lifetimes were determined with the recoil distance technique. Slow feeding times into high spin states of ~ 10 ps were observed, showing for the first time that they are not always fast (< 1 ps), as has been previously assumed.

46966 (ANL—85-22, pp 82-83) **Total γ-spectrum from ^{153}Ho measured with BGO Compton-suppressed spectrometers.** Radford, D.C.; Khoo, T.L.; Ahmad, I.; Helppi, H.; Holzmann, R.; Janssens, R.V.F.; Driggert, M.; Garg, U. Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have employed two Compton-suppressed-spectrometers to measure the α spectra emitted at 0° and 90° by ^{153}Ho formed in the reaction 165 MeV ^{37}Cl + ^{120}Sn. By tagging on the decay of a 229 ns isomer in this nucleus it was possible to obtain spectra emitted by this and only this nucleus. The combination of Compton-suppression and selection of a single-channel with delayed coincidence tagging produces an impressively clean spectrum. The CSS's, each consisting of a Ge detector with a BGO shield, are prototypes of the larger system being constructed by the Notre Dame-Argonne collaboration. The virtue of using a CSS, as opposed to a NaI detector, is that all features of the spectrum, including sharp lines, can be distinguished in the same detector. These data, the feeding times, and other available information suggest that the γ-decay starts out with a fast collective E2 cascade and is then funnelled, in a small spin range (ΔI ~ 8), into the aligned-particle configurations of the yrast line through stats of similar character. The data suggests a definite paucity of collective excitations in the vicinity (≦ 2 Me) of the yrast line.

46967 (ANL—85-22, pp 85-87) **K X-ray yields, M1 strength and the γ-ray quasicontinuum in ^{153}Ho.** Janssenns, R.V.F.; Radford, D.C.; Ahmad, I.; van den Berg, A.M. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The study of M1 strength in quasicontinuum spectra of nuclei at the beginning of the rare earth region could provide important information on the nature of collective motion known to occur at high spin. With this in mind, the authors have performed measurements of K-shell ionization yields in ^{153}Ho, as a function of the incident beam energy, and thus also as a function of angular momentum. X-ray spectra from a small Ge detector, as well as γ-ray spectra from a large Ge detector and a 5" x 5" NaI(Tl) detector were recorded for the ^{120}Sn(^{37}Cl,4n) reaction at 6 beam energies between 150 and 175 MeV. At the lowest beam energies the measured x-ray multiplicity is essentially comparable with that calculated from the internal conversion of the known discrete lines. However, as more angular momentum is added to the system the increase in the measured x-ray multiplicity is found to be much larger than the one calculated. This result implies the presence of other highly converted transitions populated at spins in excess of 40 h. The present analysis provides evidence that low-energy M1 strength occurs at very high spin in ^{153}Ho. A substantial fraction of this strength is carried through very weak lines with E/sub γ/ ≦ 350 keV.

46968 (ANL—85-22, pp 88) **Study of high spin states in ^{155}Ho.** Radford, D.C.; Helppi, H.; Janssens, R.V.F.; Khoo, T.L.; Broda, R.; Daly, P.J.; Grabowski, Z.W.; McNeill, J. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Changes in the character of yrast levels are of particular interest since they are a sensitive test of our understanding of the interplay between collective and single-particle modes of excitation. To further extend the systematics of the transition the authors have chosen to study high-spin states in ^{155}Ho, an isotone of ^{154}Dy. The analysis of an angular distribution measurement and of a γ-γ coincidence experiment performed last year has continued but is rather difficult. This is due to the complexity of the decay scheme which translates into the occurrence of a large number of weak γ-rays difficult to place in a level scheme consistent with all the data. Nevertheless, preliminary results indicate a transition to an oblate shape at a spin in excess of 55/2 h. This shape change is probably responsible, at least in part, for the complexity of the γ-decay mentioned above.

46969 (ANL—85-22, pp 89-90) **Nature of the backbending in the Os-Ir-Pt region.** Garg, U.; Marshalek, E.R.; Chaudhury, A.; Funk, E.G.; Kaczarowski, R.; Mihelich, J.W.; Janssens, R.V.F.; Radford, D.C.; van den Berg, A.M. (Univ. of Notre Dame, South Bend, IN). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The structure of ^{161}Ir was investigated towards higher spins through the measurement of γ-γ coincidences with the ^{150}Nd(^{35}Cl,4n) reaction. A backbending was observed in the h/sub 9/2/ 1/2$^-$[541] band at a frequency h omega ~ 0.3 MeV with Δi/ sub x/ ~ 6.5 h. In contrast, only an upbend is measured near the same frequency in the core nucleus ^{160}Os. The nature of this backbend was explored in the framework of the cranked Hartree-Fock-Boguliubov approximation. Good agreement between the data and the calculations is obtained for ^{160}Os where the upbending is calculated to arise from the rotation-alignment of two i/sub 13/2/ neutrons. A similar upbend is predicted for the h/sub 9/2/ 1/2$^-$[541] band in ^{161}Ir. Thus, the model cannot explain how the upbend in ^{160}Os mutates into a backbend in ^{161}Ir.

46970 **(BNL-NCS—37975) Neutron cross sections for ^{152}Gd and ^{153}Gd.** Holden, N.E. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-8605158—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86012708.

From Department of Energy nuclear data committee meeting; Germantown, MD, USA (1 May 1986).

Cross section data is tabulated for ^{152}Gd and ^{153}Gd. Resonance data is given for ^{152}Gd. Both reported and revised measurements are presented for cross sections and resonance parameters. Recommendations for further cross section and resonance research for these two isotopes are made. (DWL). 15 ref., 3 tabs.

46971 **Direct laboratory determination of the ^{187}Re half-life.** Lindner, M.; Leich, D.A.; Borg, R.J.; Russ, G.P.; Bazan, J.M.; Simons, D.S.; Date, A.R. (Lawrence Livermore National Lab., CA, USA; National Bureau of Standards, Gaithersburg, MD, USA; British Geological Survey, London, UK). *Nature (London);* 320: No. 6059, 246-248(20 Mar 1986). Contract W-7405-ENG-48.

The authors report a half-life of (4.35 +- 0.13) x 10^{10} yr, for ^{187}Re based on the growth of ^{187}Os over a 4-yr period into a large source of osmium-free rhenium. Since this result agrees with the best geochemically determined values, no significant revision of the present galactic age limits based on the geochemical values is necessary. The agreement at the 5% level of the decay rates determined on laboratory and meteorite-age timescales places a tight constraint on cosmological models in which fundamental 'constants' are allowed to vary. In particular, the fine-structure constant, α, must have changed by less than one part in 10^5 over the past 4.5 x 10^9 yr.

6519 Nuclear Properties And Reactions, A=190-219, Theoretical

46972 (ANL—85-22, pp 49) **Quasi-elastic processes in Si-induced reactions on Pb and Ca.** Kolata, J.J.; Vojtech, R.; Kovar, D.G.; Rosner, G.; Rehm, K.E.; Stephans, G.S.F.; Lesko, K.T.; Vineyard, M.F. (Univ. of Notre Dame, IN). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The previous study of quasielastic processes (elastic and inelastic scattering and few-nucleon transfer) induced by ^{28}Si on targets of ^{40}Ca and ^{208}Pb was extended to new bombarding energies and additional projectile-target combinations. Measurements were performed for ^{28}Si + ^{208}Pb at E/sub Lab/ = 165 MeV to complement previously obtained results at E/sub Lab/ = 225 MeV, and for ^{28}Si, ^{30}Si + ^{206}Pb and ^{30}Si + ^{208}Pb at E/sub Lab/ = 225 MeV to study the influence of Q-values and nuclear structure. In these measurements, performed with the split-pole magnetic spectrograph, energy resolutions of 400 keV were achieved allowing study of transitions to resolved states of the final nucleus. The ^{28}Si + ^{40}Ca data have been analyzed to extract elastic, inelastic, and transfer angular distributions. These seem to display neither very strong transfer cross sections, nor strong perturbations of the elastic and inelastic scattering by coupling to the ^{28}Si 2+ state. Detailed DWBA and CCBA calculations are in progress. The Si = Pb data taken this year are presently being analyzed.

46973 (ANL—85-22, pp 50-51) **Energy dependence of quasi-elastic heavy ion reactions.** Rehm, K.E.; van den Berg, A.; Kovar, D.G.; Kutschera, W.; Lee, L.L.; Rosner, G.; Stephans, G.S.F. (Argonne National Lab., IL). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

The authors have measured the strength of different reaction channels for the system /sup 58,64/Ni + ^{208}Pb in the energy range 345-380 MeV, which is about 15-25% above the Coulomb barrier. The cross sections for one and two neutron transfer stay constant in this energy range while the integrated cross sections for charge transfer decrease with decreasing energy. In relation to the total reaction cross section which rapidly increases with energy, this implies that neutron transfer processes are increasingly more important at energies close to the barrier. The average Q-values for these channels are slightly negative.

46974 **(DOE/ER/40048—162) Heavy ion fusion and fission reactions.** Vandenbosch, R. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1986. Contract AC06-81ER40048. 24p. (CONF-8605150—2). NTIS, PC A02/MF A01. File Number DE86013147.

From Beijing symposium on physics at tandem; Beijing, China (26 May 1986).

Various methods of probing the partial wave distribution are reviewed and new results using fission fragment angular distributions are discussed. Evidence that existing models of fusion reactions near-barrier and sub-barrier energies underestimate the mean-square spin values are presented. The dynamics of fusion reactions at higher energies are also discussed. The controversy over the interpretation of fission fragment and angular distributions are reviewed. Both statistical scission models and dynamical models with incomplete K mixing are discussed. New developments related to the effective moment of inertia of the saddlepoint shape are presented.

46975 (INIS-mf—9759, pp 319-324) **High-spin states in ^{200,201}Po and systematical features of Po isotopes.** Fant, B.; Weckstroem, T.; Herrlander, C.J.; Kaellberg, A.; Loennroth, T.; Rahkonen, V. (Helsinki Univ., Finland. Dept. of Physics; Research Institute of Physics, Stockholm, Sweden; Jyvaeskylae Univ., Finland. Dept. of Physics). 1984. NTIS (US Sales Only), PC A20/MF A01. File Number DE85781595. (CONF-8403127—).

From 5. Nordic meeting on nuclear physics; Jyvaskyla, Finland (12 Mar 1984).

The present work focusses attention on excited high-spin states in ^{200,201}Po, with emphasis on the questions - are there collective effects in these nuclei or can they still be depicted as 'shell-model nuclei'.

46976 **(LBL—21580) Transfer and breakup reactions at intermediate energies.** Stokstad, R.G. (Lawrence Berkeley Lab., CA (USA). Nuclear Science Div.). Apr 1986. Contract AC03-76SF00098. 28p. (CONF-8604165—8). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86013199.

From International conference on heavy ion physics; Rochester, NY, USA (21 Apr 1986).

The origin of the quasi-elastic peak in peripheral heavy-ion reactions is discussed in terms of inelastic scattering and transfer reactions to unbound states of the primary projectile-like fragment. The situation is analogous to the use of reverse kinematics in fusion reactions, a technique in which the object of study is moving with nearly the beam velocity. It appears that several important features of the quasi-elastic peak may be explained by this approach. Projectile-breakup reactions have attractive features for the study of nuclear structure. They may also be used to determine the partition of excitation energy in peripheral reactions. At intermediate energies, neutron-pickup reactions leading to four-body final states become important. Examples of experiments are presented that illustrate these points. 15 refs., 14 figs.

46977 /sup 208/Pb+n reaction and the mean nuclear field near threshold. Horen, D.J.; Johnson, C.H.; Fowler, J.L.; MacKellar, A.D.; Castel, B. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 429-442(Aug 1986). Contract AC05-84OR21400.

Measurement of the total and differential elastic cross sections for the /sup 208/Pb+n reaction are reported for the neutron energy range E-italic = 50—1005 keV. The data have been analyzed in terms of partial waves using the R-italic-matrix formalism. The results were used to deduce optical model potentials near threshold. When the real part is expressed solely in terms of an "effective" volume and surface spin-orbit components, it is found that the depth of the "effective" volume potential exhibits an l-italicJ-italic dependence. It is noted that because of differences in the continuum wave functions in the surface region, such an effect could arise if the actual potential contained a real surface term. Relevance to the "Fermi surface anomaly" is mentioned. The observed reduced neutron strengths are compared with predictions from three microscopic models and good agreement is found.

46978 Expanding pion emitting source in Ar on Pb collisions. Beavis, D.; Chu, S.Y.; Fung, S.Y.; Keane, D.; Liu, Y.M.; VanDalen, G.; Vient, M. (Department of Physics, University of California, Riverside, California 92521). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 757-760(Aug 1986).

We report results of a pion interferometry analysis for central collisions of 1.8 GeV/nucleon Ar on Pb at the Bevalac streamer chamber. The statistics are sufficient to allow a detailed study of the spatial structure of the pion emitting source. The dependence of the size of the source on the average magnitude of the momenta of the emitted pion pairs is consistent with the picture of an expanding pion source. There are also indications that the Ar nucleus is completely stopped by the Pb target in the most central collisions.

6520 Nuclear Properties And Reactions, A=220 And Above, Theoretical

REFER ALSO TO CITATION(S) 47001, 47002

46979 (ANL—85-22, pp 39) **Beta spectra following the spontaneous fission of ^{252}Cf.** Wark, D.; Garvey, G.; Boehm, F.; Camp, J. (California Institute of Technology, Pasadena). Sep 1985. NTIS, PC A13/MF A01. File Number DE86002650.

In Physics Division annual review, 1 April 1984-31 March 1985.

Neutrino-oscillation studies using reactor sources can be made much more sensitive if the nu spectrum from the reactor is known. The fission of a heavy nucleus such as Cf or U creates neutron-rich nuclei so far from the valley of stability that their beta-decay spectra are not known. Thus a model must be employed to predict the overall beta-decay spectrum and the attendant nu spectrum. In order to test the reliability of the procedure in use the beta spectrum of the fission fragments following ^{252}Cf fission is being measured to an accuracy of 3% in shape and 5% in total yield. An actively-collimated, flat-field beta spectrometer is used.

46980 (INIS-mf—10410) Decay of the giant monopole resonance in heavy nuclei. Brandenburg, S. (Rijksuniversiteit Groningen (Netherlands)). 30 Aug 1985. 107p. NTIS (US Sales Only), PC A06/MF A01. File Number DE86703152.

In this thesis an experimental study of the properties of the giant monopole resonance (GMR) in nuclei is described. The main subject is the study of the neutron decay of the GMR in ^{208}Pb, and the fission decay of the GMR in ^{238}U. Furthermore the strength distribution and decay properties of the monopole strength in ^{24}Mg and ^{40}Ca were studied. The strength distribution of the isoscalar monopole (and also of the isoscalar dipole) strength as obtained from the angular distribution of the excited strength at small scattering angles are discussed. For the excitation of the GMR inelastic scattering at very small scattering angles, including 0°, of 120 MeV α-particles was employed. The experimental technique for performing this type of measurement at the KVI was developed in the course of this study and is the subject of a separate chapter. Includes Dutch summary; 310 refs.; 55 figs.; 9 tabs.

46981 (NEANDC(J)—121/U) Evaluation of neutron nuclear data for ^{250}Cf and ^{251}Cf. Nakagawa, Tsueno. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jun 1986. 35p. (JAERI-M—86-086; INDC(JPN)—107/L). Japan Atomic Energy Research Institute, Dept. of Technical Information, Tokaimura, NaKagun, Japan. File Number TI86901539.

Nuclear data of ^{250}Cf and ^{251}Cf have been evaluated in the energy range from 10^{-5} eV to 20 MeV. There exist only a few experimental data for the cross sections of both the isotopes, that is, the cross sections at the thermal neutron energy and the resonance integrals. Therefore, the present evaluation was based on systematic trends of the data and the claculations with the optical, statistical and evaporation models. Cross sections evaluated in this work are the total, elastic and inelastic scattering, fission, radiative capture, (n,2n), (n,3n) and (n,4n) reaction cross sections. In the energy range below 150 eV, hypothetical resonance levels were generated so as to reproduce the measured thermal cross sections and resonance integrals. Other evaluated quantities are the angular distributions of elastically and inelastically scattered neutrons and those of neutrons emitted from the (n,2n), (n,3n), (n,4n) and fission reactions, their energy distributions, and average numbers of neutrons emitted per fission. The results were compiled in the ENDF/B-V format. 28 refs., 16 figs., 1 tab.

46982 Fragment angular distributions for neutron fission of /sup 232/Th. Becker, J.A.; Bauer, R.W. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review [Section] C: Nuclear Physics;* 34: No. 2, 594-600(Aug 1986). Contract W-7405-ENG-48.

Fission fragment angular distributions were measured for the neutron-induced fission of /sup 232/Th at incident energies from threshold to 6 MeV, using a white source of neutrons, time-of-flight techniques, and position-sensitive multiwire counters subtending a solid angle of nearly 2π sr. The experimental data were analyzed in incident neutron energy bins of 40 keV and angular bins of 9 deg, and compared with previous results which were available for only partial energy ranges covered by this experiment. A channel analysis yielded relative strengths for the K-italic transition states with K-italic = (1/2), (3/2), and (5/2) from threshold to E-italic/sub n/ = 4.5 MeV.

46983 Subthreshold fission cross section of ^{240}Pu and the fission cross sections of ^{235}U and ^{239}Pu. Weston, L.W.; Todd, J.H. (Oak Ridge National Lab., TN). *Nuclear Science and Engineering;* 88: 567-578(1984).

The subthreshold fission cross section of 240 Pu was measured relative to the ^{10}B(n,α) or the ^{6}Li(n,α) cross sections from 20 eV to 100 keV. Resonance parameter fits to the data were derived from 20 to 5700 eV. Many more resonances and more resonance structure were observed than in previous measurements. During the course of this measurement, the fission cross sections of ^{235}U and ^{239}Pu were also measured and are compared to the ENDF/B-V evaluation. The ^{235}U experiment is in good agreement with ENDF/B-V; however, the ^{239}Pu measurement is lower than ENDF/B-V and many of the previous measurements, particularly above 25 KeV. 16 references, 12 figures, 8 tables.

6530 Nuclear Theory

46984 (AD-A—167490/2/XAB) Hartree-Fock theory in nuclear physics. Technical summary report. Goyny, D.; Lions, P.L. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Feb 1986. 75p. (MRC-TSR—2914). NTIS, PC A04/MF A01.

This document investigates the so-called Hartree-Fock theory arising in the study of the structure of nuclei. The Hartree-Fock theory is an approximation method of many-body problems modelling the interaction of nucleons (neutrons and protrons), which lead to nonlinear variational systems of elliptic equations (the Hartree-Fock equations). These equations pertain to questions

related to spin dependence and spin-orbit forces, symmetries of the nucleus and symmetry breakings, and time-dependent Hartree-Fock equations. One of the main features of these problems is the translation invariance, which creates compactness difficulties that are overcome by the use of the concentration-compactness method.

46985 **(DOE/ER/02853—29) Non-mesonic decay of hypernuclei.** Dubach, J. (Massachusetts Univ., Amherst (USA)). 1986. Contract AC02-76ER02853. 7p. (CONF-860575—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013356.

From 2. conference on particle and nuclear physics; Lake Louise, Canada (26 May 1986).

The $\Delta N \rightarrow NN$ non-mesonic decay mode of hypernuclei is examined in a model that employs a weak, strangeness-changing meson exchange potential in a Fermi gas model of the hypernucleus. Results are in good agreement with recent experiments for $A = 11$ and $A = 12$ hypernuclei. The calculations suggest that the ratio of proton-stimulated to neutron-stimulated decays and the ratio of parity-violating to parity-conserving decays are particularly sensitive to the details of the model. Finally, preliminary results using a more sophisticated shell model of the hypernucleus are discussed. 13 refs., 2 tabs.

46986 **(DOE/ER/02853—30) Theoretical aspects of the weak decay of hypernuclei.** Dubach, J. (Massachusetts Univ., Amherst (USA). Dept. of Physics and Astronomy). 1986. Contract AC02-76ER02853. 9p. (CONF-860741—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013355.

From International symposium on weak and electromagnetic interactions in nuclei; Heidelberg, F.R. Germany (1 Jul 1986).

The present status of theoretical descriptions of mesonic ($\Lambda \rightarrow N\pi$) and non-mesonic ($\Lambda N \rightarrow NN$) decay modes of hypernuclei is reviewed. Calculations for the non-mesonic mode are discussed in some detail within the context of a model which describes the strangeness-changing, parity-violating, $\Lambda N \rightarrow NN$ "transition potential" in terms of π, rho, ω, eta, K, K*, and "σ" exchanges. Results are presented for the total decay rate, the ratio of proton- to neutron-stimulated decay rates, and the as yet unmeasured ratio of parity-violating to parity-conserving decay rates. Calculations for nuclear matter, which are in reasonable agreement with experiment, suggest that these rates (particularly the two ratios) can provide important tests of the form of the transition potential. Considerations of finite hypernuclei are also discussed. Finally, other theoretical approaches and the present experimental situation are briefly summarized. 17 refs., 3 figs., 3 tabs.

46987 **(IFUSP-P—518) Symmetries of the vacuum.** Fleming, H. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1985. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703111.

The vacuum equation of state required by cosmological inflation is taken seriously as a general property of the cosmological vacuum. This correctly restricts the class of theories which admit inflation. A model of such a vacuum is presented that leads naturally to the cosmological principle.

46988 **(INS—534) Origin of nuclear mass number dependence in EMC-effect.** Kurihara, Y.; Date, S.; Nakamura, A.; Sato, H.; Sumiyoshi, H.; Yoshinada, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703147.

The origin of the mass number dependence of the nucleon structure functions extracted from the deep inelastic lepton-nucleus scattering is investigated by factorizing the structure function into A and x dependent parts. It is found that the mass number dependence is determined by the probability of exotic components in multi-nucleon overlap. This suggests that the deformation of the nucleon structure function is caused by the interaction among nucleons during their overlap.

46989 **(INS—535) Nuclear stopping power at high energies.** Date, S.; Gyulassy, M.; Sumiyoshi, H. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Mar 1985. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703148.

Recent $p + A \rightarrow p + X$ data are analyzed within the context of the multi-chain and additive quark models. We deduce the average energy loss of a baryon as a function of distance traversed in nuclear matter. Consistency of the multi-chain model is checked by comparing the predictions for $p + A \rightarrow \pi^{+-} + X$ with data. We discuss the space-time development of baryon stopping and show how longitudinal growth limits the energy deposition per unit length. Predictions are made for the proton spectra to be measured in nucleus-nucleus collisions at CERN and BNL. Finally, we conclude that the stopping domain for central collisions of heavy ions extends up to center of mass kinetic energies KEsub(em) asymptotically equals 3 +- 1 AGev.

46990 **(INS—538) EMC effect and breaking of additivity of nucleons in the high-energy hadron-nucleus interactions.** Nikolaev, N.N. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Apr 1985. 48p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703149.

The EMC effect implies a strong violation of additivity of nucleons in the absorption of virtual photons by atomic nuclei. In this paper we analyze the experimental data on the hadron-nuclei interaction cross sections in search for similar effects in the scattering of hadrons on nuclei. Specifically, we look for deviations from predictions of the multiple scattering theory. We formulate, and make extensive use of the Glauber-Gribov universality of the hadron-nucleus interaction cross sections, which makes it possible to check in a unique way a consistency of the experimental data on the total, inelastic and absorption cross sections for all the incident hadrons. We find evidence for the effective cross section of interaction with bound nucleons being 5-15 % larger than with free nucleons. We comment on implications of this observation for models of the EMC effect.

46991 **(LBL—21462) Nucleon exchange in damped nuclear reactions.** Randrup, J. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 20p. (CONF-8604165—9). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013203.

From International conference on heavy ion physics; Rochester, NY, USA (21 Apr 1986).

Starting from the general context of one-body nuclear dynamics, the nucleon-exchange mechanism in damped nuclear reactions is discussed. Some of its characteristic effects on various dinuclear observables are highlighted and a few recent advances are described.

46992 **(SLAC-PUB—3973) Minimal relativistic model for the three nucleon system.** Noyes, H.P. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1986. Contract AC03-76SF00515. 4p. (CONF-8604194—5). NTIS, PC A02/MF A01; GPO Dep. File Number DE86012961.

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

A start is made on disentangling relativistic kinematic effects from "three body forces" by presenting a minimal relativistic model in which the internal mesonic degree of freedom is treated on the same footing as the nucleonic degrees of freedom. The meson is not allowed to appear asymptotically, specifying the two-nucleon "off shell" amplitudes which can be used to calculate the three nucleon problem. The results are identical to those obtained from the same model starting from three nucleons and one meson. In effect we have discovered a "relativistic potential model" which does not generate "three body forces". 14 refs.

46993 **Ground state energy of a hard-sphere Fermi fluid.** Baker G.A. Jr.; Benofy, L.P.; Fortes, M.; de Llano, M. (Theoretical Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* 34: No. 2, 678-685(Aug 1986).

A new method of computing the ground state energy of a Fermi fluid is developed and applied to the hard-sphere Fermi fluids of two and four components. We find the results to be highly accurate for low densities. In this paper we compute and report the perturbation series for the ground state energy for the soft, repul-

sive, square-well problem at a number of densities for a four-component Fermi system as well as the ladder approximation energies for a hard-sphere potential at the same densities.

46994 **Resolution of the magnetic moment problem in relativistic theories.** McNeil, J.A.; Amado, R.D.; Horowitz, C.J.; Oka, M.; Shepard, J.R.; Sparrow, D.A. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 746-749(Aug 1986).

A Landau-Migdal approach to relativistic mean field theory of nuclear matter is used to define the single particle isoscalar current. By virtue of the near cancellation of scalar and vector potentials, this current is very close to the standard nonrelativistic isoscalar current; and hence the single particle isoscalar magnetic moment operator gives results in agreement with the nonrelativistic shell model. Calculations of magnetic moments for closed shell plus (or minus) one nucleon using this effective current operator recover the Schmidt values, thus resolving a longstanding problem with relativistic models of nuclear structure.

46995 **Direct E-italic2 neutron capture in light nuclei.** Castel, B.; Ho, Y.K. (Physics Department, Queen's University, Kingston, Canada). *Physical Review [Section] C: Nuclear Physics;* **34**: No. 2, 408-412(Aug 1986).

We present an analysis of the E-italic2 strength data recently available from thermal radiative neutron capture within the context of direct capture theory. The radiative capture data require a neutron E-italic2 effective charge identical to the one used in bound state shell model calculations, in marked contrast to the E-italic1 situation. We suggest that this difference has its origin in the nature of the coupling governing the particle-core interaction in E-italic2 and E-italic1 radiative capture processes.

46996 **Exotic states in QED.** Celenza, L.S.; Mishra, V.K.; Shakin, C.M.; Liu, K.F. (Department of Physics and Center for Nuclear Theory, Brooklyn College of the City University of New York, Brooklyn, New York 11210). *Physical Review Letters;* **57**: No. 1, 55-57(7 Jul 1986).

We suggest that electron and positron peaks seen in large-Z-italic heavy-ion collisions originate in the decay of nontopological solitons consisting of a quasielectron and quasipositron which are formed in a new vacuum phase.

46997 **Monte Carlo studies of nuclear many-particle systems.** Negele, J.W. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Statistical Physics;* **43**: No. 3, 991-1016(Jun 1986).

Stochastic evaluation of path integrals provides a useful tool for the study of a variety of nuclear systems which are otherwise not amenable to definitive analysis through perturbative, variational, or stationary-phase approximations. Ground state properties of potential models, such as quantum fluctuations in the density, are examined. Tunneling problems in quantum many-particle systems, such as spontaneous fission and the ground state structure of systems with degenerate vacuua are treated by incorporating one's physical understanding of the essential collective degrees of freedom i the stochastic algorithm. The role of subnuclear degrees of freedom is studied by comparing the exact solution of a simple confining quark model with the solution to a phase-shift equivalent hadronic potential model.

46998 **Spectral averaging and partition functions.** French, J.B. (Dept. of Physics and Astronomy, Univ. of Rochester, Rochester, NY 14627). pp 100-121 of Mathematical and computational methods in nuclear physics. Dehesa, J.S.; Gomez, J.M.G.; Polls, A. New York, NY; Springer-Verlag New York, Inc. (1983). (CONF-8310420—).

From 6. Granada workshop on mathematical and computational methods in nuclear physics; Granada, Spain (3 Oct 1983).

The aim of statistical spectroscopy, of which spectral averaging is one part and spectral fluctuations the other, is to produce and apply a kind of statistical mechanics which takes account of small particle number, the importance of shell structure, and the role of symmetries and special features of the Hamiltonian. It should be valid of course at high excitations, the obvious domain of statistical behaviour. But it should extend also into the ground-state region, giving results there which are directly useful, or it should join on to theories which are valid in that domain. By spectral averaging the authors mean local averaging over states of a system which has a specified microscopically defined Hamiltonian. Then by a spectral distribution they mean the locally averaged (smoothed) distribution in energy of the quantity of interest: for example the level density will be the spectral distribution which corresponds to the spectrum itself. In some cases multivariate distribution (for example with respect to E,J), or distributions with different variables, may also be considered. In any case such distributions, expressed as explicit functions of the microscopic matrix elements (of H and other operators involved) is the subject of this discussion.

46999 **NN and πD reduced widths of dibaryon resonances.** Duck, I.; Umland, E. (Rice Univ., Houston, TX). *Physics Letters [Section] B;* **96B**: No. 3-4, 230-232(3 Nov 1980).

The reduced widths of the conjectured $J = 2^+$ (2180) and $J = 3\pi$ (2220) dibaryon resonances in NN and D channels are calculated. The dibaryon resonances show up in proton-proton elastic scattering channels as very inelastic resonances with partial widths in the NN channel about 1/5 of the total width. Dibaryon resonance contributions to differential cross sections and polarization parameters were investigated using the coupling constants as adjustable parameters.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 47061

47000 **(INDC(BUL)—011/L) Legendre-series development of the anisotropy density of neutron elastic scattering by means of cubic splines.** Voykov, G.; Gadjokov, V.; Ilieva, K. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Feb 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703141.

The Legendre-series coefficients of the anisotropy density of neutron elastic scattering are computed starting from tabulated data and using the basis of natural cubic splines. The method is implemented and incorporated in the SUPERTOG package. Processing results are reported and compared with previous ones. 3 refs, 4 tabs.

47001 **(INDC(CCP)—253/L) Evaluation of resonance self-shielding factors for ^{238}U in the unresolved resonance region.** Komarov, A.V.; Luk'yanov, A.A. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703142.

On the basis of a theoretical model of identical equidistant resonances for the energy dependence of cross-sections in the unresolved resonance region, the authors have parametrized the values of the resonance self-shielding factors and their Doppler increments for ^{238}U. They have proposed a method by which the Doppler increments of the self-shielding factors can be calculated from simple analytical formulae by redetermination of the model parameters. Analysing the experimental data on direct and capture transmissions in the unresolved resonance region, they demonstrate the possibility of describing those data as a whole and of deriving from them the cross-section group functionals. Translated from Russian. 20 refs, 2 figs, 4 tabs.

47002 **(INDC(CCP)—254/L) Group cross-sections and resonance self-shielding factors for ^{239}Pu in the unresolved resonance region.** Van'kov, A.A.; Toshkov, S.; Ukraintsev, V.F.; Yaneva, N. (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Jan 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703143.

The authors analyse experimental data on the transmission and fission self-indication functions for ^{239}Pu in the unresolved resonance region. Use is made of the method of generating a cross-section structure based on the multi-level R-matrix formalism (stochastic K-matrix method). Evaluations of the average resonance parameters and group constants for ^{239}Pu are made. Translated from Russian. 15 refs, 3 figs.

47003 (INIS-mf—10173, pp 53) **Drift properties of electrons in gases.** Schmidt, B. (Heidelberg Univ., Germany, F.R. Physikalisches Inst.). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

47004 (INIS-mf—10173, pp 36) **Attenuation length measurement in narrow drift channels.** Rossi, L.; Gracco, V.; Sannino, M.; Traspedini, L. (European Organization for Nuclear Research, Geneva, Switzerland). Feb 1986. NTIS (US Sales Only), PC A05/MF A01. File Number DE86703196. (CONF-860272—Absts.).

From Wire chamber conference; Vienna, Austria (25 Feb 1986).

47005 **(INIS-mf—10412) Slowing down and straggling of protons and heavy ions in matter.** Aernsbergen, L.M. van. (Rijksuniversiteit Groningen (Netherlands)). 17 Jan 1986. 150p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703116.

The Doppler Shift Attenuation (DSA) method is widely used to measure lifetimes of nuclear states. However, many of the lifetimes resulting from DSA measurements display large variations which are caused by an insufficient knowledge of slowing down processes of nucleus recoils. The measurement of 'ranges' is an often used method to study these slowing down processes. In this kind of measurement the distributions of implanted ions are determined for example by the method of Rutherford backscattering or from the yield curve of a resonant nuclear reaction. In this thesis, research on energy-loss processes of protons and Si ions in aluminium is presented. The so-called Resonance Shift method has been improved for the measurements on the protons themselves. This method has only been used occasionally before. A new method has been developed, which is called the Transmission Doppler Shift Attenuation (TDSA) method, for the measurement on Si ions. Includes Dutch summary; 145 refs.; 49 figs.; 10 tabs.

47006 **(RAL—85-017) Monte Carlo evaluation of analytical multiple scattering corrections for unpolarised neutron scattering and polarisation analysis data.** Mayers, J.; Cywinski, R. (Rutherford Appleton Lab., Chilton (UK)). Mar 1985. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86703144.

Some of the approximations commonly used for the analytical estimation of multiple scattering corrections to thermal neutron elastic scattering data from cylindrical and plane slab samples have been tested using a Monte Carlo program. It is shown that the approximations are accurate for a wide range of sample geometries and scattering cross-sections. Neutron polarisation analysis provides the most stringent test of multiple scattering calculations as multiply scattered neutrons may be redistributed not only geometrically but also between the spin flip and non spin flip scattering channels. A very simple analytical technique for correcting for multiple scattering in neutron polarisation analysis has been tested using the Monte Carlo program and has been shown to work remarkably well in most circumstances.

47007 **(ZfK—562) Proceedings of the 14. International Symposium on the Interaction of Fast Neutrons with Nuclei - Neutron Generators and Application - organized by the Technical University of Dresden.** Seeliger, D.; Jahn, U. (eds.). (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Jul 1985. 131p. (In English and Russian). (CONF-8411262—). NTIS (US Sales Only), PC A07/MF A01. File Number DE86703145.

From 14. international symposium on the interaction of fast neutrons with nuclei; Gaussig, German D.R. (19 Nov 1984).

The symposium was devoted to current problems of intense fast neutron sources, especially 14 MeV DT-neutron generators, and their broad spectrum of application in nuclear physics. 56 participants from 12 countries and the IAEA demonstrate the high interest on this selected topic. The submitted contributions can be divided into two general parts. The first one gives a review about the different possibilities of the technical and technological solution in development, the present status of operation and also the problems connected with the use of intense neutron sources. Various experimental arrangements for neutron spectroscopy, determination of nuclear data and theoretical aspects are the content of the second part. The participation in this meeting of designer and operators on the one hand and users of neutron sources on the other hand was a good choice and stimulated productive discussions during the conference.

6550 Medical Physics

REFER ALSO TO CITATION(S) 45987, 46637

47008 **(DOE/EV/03333—T8) Compton scatter correction for the MGH analog ring positron camera.** Wolfson, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 1986. Contract AC02-76EV03333. 50p. Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139. File Number TI86012566.

Thesis.

A technique for reducing Compton scatter effects in positron tomographs is demonstrated. A cylindrical container of water is used to approximate the properties of the brain. The contribution of scattered radiation to point source images is observed. The dependency of this contribution on point source location is quantified. By regarding an arbitrary image as an aggregation of point sources, the total scatter distribution may be calculated as a weighed superposition of the measured contributions. A Monte Carlo simulation is used to investigate the dependence of scatter effects on cylinder radius and on activity outside the image plane. The correction scheme is tested with several phantoms. 9 refs., 14 figs.

47009 (INIS-mf—10402, pp 15) **Evolution of radiation protection standards.** Swindon, T.N. (Australian Radiation Lab., Melbourne). Aug 1985. NTIS (US Sales Only), PC A04/MF A01. File Number DE86780480. (CONF-8508179—).

From 10. AINSE radiation biology conference; Lucas Heights, Australia (22 Aug 1985).

47010 **(ORNL—6296) Eleventh ORNL personnel dosimetry intercomparison study, May 22-23, 1985.** Swaja, R.E.; Oyan, R.; Sims, C.S. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; GPO Dep. File Number DE86013815.

The Eleventh Personnel Dosimetry Intercomparison Study was conducted at the Oak Ridge National Laboratory (ORNL) during May 22-23, 1985. Dosimeter badges from 44 participating organizations were mounted on Lucite block phantoms and exposed to four mixed-radiation fields with neutron dose equivalents around 5 mSv and gamma dose equivalents between 0.1 and 0.7 mSv. Results of this study indicated that no participants had difficulty obtaining measurable indication of neutron exposure at the provided dose equivalent levels, and very few had difficulty obtaining indication of gamma exposure at dose equivalents as low as 0.10 mSv. Average neutron results for all dosimeter types were within 20% of reference values with no obvious spectrum dependence. Different dosimeter types (albedo, direct interaction TLD, film, recoil track,

and combination albedo-track) with 10 or more reported measurements provided average results within 35% of reference values for all spectra. With regard to precision, about 80% of the reported neutron results had single standard deviations within 10% at the means which indicates that precision is not a problem relative to accuracy for most participants. Average gamma results were greater than reference values by factors of 1.07 to 1.52 for the four exposures with TLD systems being more accurate than film. About 80% of all neutron results and 67% of all gamma results met regulatory standards for measurement accuracy and approximately 70% of all neutron data satisfied national dosimetry accreditation criteria for accuracy plus precision. In general, neutron dosimeter performance observed in this intercomparison was much improved compared to that observed in the prior studies while gamma dosimeter performance was about the same.

6560 Solid-state Physics

REFER ALSO TO CITATION(S) 46154, 46193, 46865, 46866

47011 **(IFUSP-P—549) On the equivalence of dilute antiferromagnets and ferromagnets in random external fields: Curie-Weiss models.** Perez, J.F.; Pontin, L.F.; Segundo, J.A.B. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Escola Federal de Engenharia de Itajuba, Minas Gerais (Brazil). Inst. Basico). 1985. 9p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703115.

Using a method proposed by van Hemmen the free energy of the Curie-Weiss version of the site-dilute antiferromagnetic Ising model is computed, in the presence of an uniform magnetic field. The solution displays an exact correspondence between this model and the Curie-Weiss version of the Ising model in the presence of a random magnetic field. The phase diagrams are discussed and a tricritical point is shown to exist.

47012 **(LA-UR—86-2528) Model of cohesive properties and structural phase transitions in non-metallic solids.** Majewski, J.A.; Vogl, P. (Los Alamos National Lab., NM (USA). Center for Nonlinear Studies; Polska Akademia Nauk, Warsaw. Inst. Fizyki; Graz Univ. (Austria). Inst. fuer Theoretische Physik). 1986. Contract W-7405-ENG-36. 5p. (CONF-860892—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013832.

From 18. international conference on physics of semiconductors; Stockholm, Sweden (11 Aug 1986).

We have developed a simple, yet microscopic and universal model for cohesive properties of solids. This model explains the physical mechanisms determining the chemical and predicts semiquantitatively static and dynamic cohesive properties. It predicts a substantial softening of the long-wavelength transverse optical phonons across the pressure induced phase transition from the zincblenda to rocksalt structure in II-VI compounds. The origin of this softening is shown to be closely related to ferroelectricity.

47013 **Monte Carlo simulation of continuous-space crystal growth.** Dodson, B.W.; Taylor, P.A. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2112-2115(15 Aug 1986). Contract AC04-76DP00789.

We describe a method, based on Monte Carlo techniques, of simulating the atomic growth of crystals without the discrete lattice space assumed by conventional Monte Carlo growth simulations. Since no lattice space is assumed, problems involving epitaxial growth, heteroepitaxy, phonon-driven mechanisms, surface reconstruction, and many other phenomena incompatible with the lattice-space approximation can be studied. Also, use of the Monte Carlo method circumvents to some extent the extreme limitations on simulated timescale inherent in crystal-growth techniques which might be proposed using molecular dynamics. The implementation of the new method is illustrated by studying the growth of strained-layer superlattice (SLS) interfaces in two-dimensional Lennard-Jones atomic systems. Despite the extreme simplicity of such systems, the qualitative features of SLS growth seen here are similar to those observed experimentally in real semiconductor systems.

47014 **Spin-orbit splitting in semiconductors and insulators from the a-italicb-italic i-italicn-italici-italict-italici-italico-italic pseudopotential.** Hybertsen, M.S.; Louie, S.G. (Department of Physics, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **34**: No. 4, 2920-2922(15 Aug 1986). Contract AC03-76SF00098.

In this Brief Report, we give the expressions required for using the vector (spin-orbit) part of the a-italicb-italic i-italicn-italici-italict-italici-italico-italic pseudopotential in a crystalline calculation. Inclusion of the spin-orbit interaction using the vector part of the pseudopotential in first order reproduces the measured spin-orbit splittings in Ge as well as the rare-gas solids and agrees with all-electron calculations.

47015 **Indirect phase detection of NMR spinor transitions.** Suter, D.; Pines, A.; Mehring, M. (Department of Chemistry, University of California, Berkeley, California 94720 and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **57**: No. 2, 242-244(14 Jul 1986). Contract AC03-76SF00098.

The behavior of quantum mechanical state functions under selective rotations is discussed. If a two-level transition is phase shifted with composite z-italic pulses, the component state function shared with a connected transition can be multiplied by i-italic, thereby shifting the corresponding coherence into an orthogonal channel. Application to the sensitive indirect detection of NMR transitions is demonstrated.

47016 **Dissipation due to a "valley wave" channel in the quantum Hall effect of a multivalley semiconductor.** Rasolt, M.; Halperin, B.I.; Vanderbilt, D. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **57**: No. 1, 126-129(7 Jul 1986). Contract AC05-84OR21400.

When the quantized Hall effect occurs at a semiconductor surface such as Si(110), where the carriers have a time-reversal valley degeneracy, there should be a spontaneous valley polarization at appropriate values of the filling factor ν. There can then be dissipation at T-italic = 0 due to radiation of Goldstone bosons ("valley waves") at impurity sites, provided that the current density exceeds a critical value j-italic/sub c-italic/ determined by the intervalley electron-electron scattering or other terms which modify the valley-wave dispersion at long wavelengths. The dissipation above j-italic/sub c-italic/ is described by a constant resistivity rho/sub x-italic//sub x-italic/, which should be small but measureable, and sensitive to the density of neutral impurities.

47017 **Analysis of the decay of picosecond fluorescence in semiconductors. Criteria for the presumption of electroneutrality during the decay of an exponential electron-hole profile.** Feldberg, S.W.; Evenor, M.; Huppert, D.; Gottesfeld, S. (Brookhaven National Lab., Upton, NY). *Journal of Electroanalytical Chemistry;* **185**: 209-228(1985). Contract AC02-76CH00016.

When an exponential profile of electron-hole pairs is photogenerated (in a semiconductor) with a delta-function light pulse, unequal diffusion coefficients of holes and electrons (i.e. D/sub e/ not equal to D/sub h/) effect deviations from electroneutrality as electrons and holes diffuse into the bulk semiconductor. These deviations will in turn effect errors in the analysis of data (e.g. time resolved fluorescence) when using theory based on the presumption of electroneutrality. The authors deduce here the experimental conditions required for an effective electroneutrality to be maintained during the course of an experiment. Analyses were carried out using computer simulations without the presumption of electroneutrality and the analytic solution with the presumption of electroneutrality. The differences in the measured fluorescences predicted by the two computations are characterized as a function of a variety of experimental parameters and physical properties: intensity (of the excitation pulse), the absorption of the exciting and emitted light, the ratio D/sub h//D/sub e/, bulk dielectric constant of the semiconductor, bulk and surface recombination kinetics. It is shown that

a condition of adequate electroneutrality can be effectively attained when a well defined a minimum number of electron-hole pairs is generated; an upper limit of the number of e^--h^+ pairs is also established in order to avoid an intolerable temperature pulse. 12 references, 10 figures, 1 table.

6561 Superconductivity

REFER ALSO TO CITATION(S) 46124, 46159, 46162, 46165

47018 **Recursion method in the k-space representation.** Anlage, S.M.; Smith, D.L. (Department of Applied Physics, California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *B: Condensed Matter;* **34**: No. 4, 2336-2345(15 Aug 1986).

We show that by using a unitary transformation to k space and the special-k-point method for evaluating Brillouin-zone sums, the recursion method can be very effectively applied to translationally invariant systems. We use this approach to perform recursion calculations for realistic tight-binding Hamiltonians which describe diamond- and zinc-blende-structure semiconductors. Projected densities of states for these Hamiltonians have band gaps and internal van Hove singularities. We calculate coefficients for 63 recursion levels exactly and for about 200 recursion levels to a good approximation. Comparisons are made for materials with different magnitude band gaps (diamond, Si, α-Sn). Comparison is also made between materials with one (e.g., diamond) and two (e.g., GaAs) band gaps. The asymptotic behavior of the recursion coefficients is studied by Fourier analysis. Band gaps in the projected density of states dominate the asymptotic behavior. Perturbation analysis describes the asymptotic behavior rather well. Projected densities of states are calculated using a very simple termination scheme. These densities of states compare favorably with the results of Gilat-Raubenheimer integration.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 46438, 46843, 46864, 46867, 46870, 46873, 47028

47019 **(ORNL/TM—10034) Vectorized difference schemes for a three dimensional enthalpy formulation for phase change problems.** Williams, M.A.; Wilson, D.G. (Oak Ridge National Lab., TN (USA)). Jul 1986. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014402.

Fully vectorized codes have been written for the CRAY X-MP implementing explicit and implicit finite difference schemes for enthalpy formulations of three dimensional Stefan-like problems. The implicit scheme is that proposed by C.M. Elliot and J.R. Ockendon. The explicit scheme is intended to provide a comparison for the results from the implicit scheme. Vectorization of the code required some ingenuity since material properties change discontinuously as solidification proceeds. Boolean variables were used to avoid conditional branches in DO loops. Average vector length was greatly increased by unfolding three dimensional arrays and treating them as long vectors. This report documents the development of the code and the vectorization strategies. The investigation of the tradeoffs between the implicit scheme, potentially capable of taking large time steps, and the explicit scheme, whose time step size is limited by the stability criterion, has begun but is not complete. 4 refs., 6 figs.

47020 **Numerical method for unitary systems.** Shipsey, E.J. (Department of Physics, University of Texas, Austin, Austin, Texas 78712). *Journal of Computational Physics;* **66**: No. 1, 218-224(Sep 1986).

A method of constructing probability amplitudes is presented for cases in which the corresponding unitary propagator can be expressed in terms of the Cayley representation. The method is most appropriate when the Hermitian matrix in the Cayley representation is sparse. The algorithm is organized for minimum storage.

47021 **Scattering of a pulse by a cavity in an elastic half-space.** Scandrett, C.L.; Kriegsmann, G.A.; Achenbach, J.D. (Department of Engineering Sciences and Applied Mathematics, Technological Institute, Northwestern University, Evanston, Illinois 60201). *Journal of Computational Physics;* **65**: No. 2, 410-431(Aug 1986).

The finite difference technique is employed to study plane strain scattering of pulses from finite anomalies embedded in an isotropic, homogeneous, elastic half-space. In particular, the scatterer is taken to by a cylindrical cavity. A new transmission boundary condition is developed which transmits energy conveyed by Rayleigh surface waves. This condition is successfully employed in reducing the domain of numerical calculations from a semi-infinite to a finite region. A test of the numerical scheme is given by considering a time harmonic pulse of infinite extent. The numerical technique is marched out in time until transients have radiated away and a steady state solution has been reached which is found to be in good agreement with results produced by a series type solution. Time domain solutions are given in terms of time histories of displacements at the half-space free surface; and by sequences of snapshots, taken of the entire numerical domain, which illustrate the scattering dynamics.

47022 **Tricritical points in three-dimensional X-italicY-italic model with mixed action.** Janke, W.; Kleinert, H. (University of California, San Diego, La Jolla, California 92093). *Physical Review Letters;* **57**: No. 3, 279-282(21 Jul 1986).

We present theoretical arguments (using mean fields and strong-coupling graphs) for a line of first-order phase transitions in the three-dimensional X-italicY-italic model with the mixed action β cos(del/sub i-italic/theta)+γ cos(2del/sub i-italic/theta) where $\gamma\epsilon(0.35,0.40)$, and verify its existence by a Monte Carlo simulation.

47023 **Periodically pulsed spin dynamics: Scaling behavior of semiclassical wave functions.** Nakamura, K.; Okazaki, Y.; Bishop, A.R. (Fukuoka Institute of Technology, Higashi-ku, Fukuoka 811-02, Japan). *Physical Review Letters;* **57**: No. 1, 5-8(7 Jul 1986).

Quantum analogs of Kolmogorov-Arnol'd-Moser tori and chaos in a periodically pulsed single-spin system are studied in the semiclassical regime. Wave functions (quasienergy states) are described in a spin-coherent state representation. Their projected binary-phase patterns are characterized in terms of the fractal dimensions of their perimeters.

47024 **Algebraic approach to dissociation from bound states.** Alhassid, Y.; Engel, J.; Iachello, F. (A. W. Wright Nuclear Structure Laboratory, New Haven, Connecticut 06511). *Physical Review Letters;* **57**: No. 1, 9-12(7 Jul 1986).

An algebraic treatment of continuous spectra based on noncompact groups is extended to allow discussion of dissociation from bound states. Transition matrix elements between bound and continuum states can be evaluated algebraically by the construction of transition operators that transform according to the infinite-dimensional unitary representations of the noncompact dynamical group. The method is employed to calculate dissociation rates in the Morse potential, for which the relevant group is SO(2,1).

47025 **Approximate theory of Stokes amplification and conversion valid at large gain.** Druehl, K.J.; Shakir, S.; Yousaf, M. (Institute for Modern Optics, Center for High Technology Materials, University of New Mexico, Albuquerque, New Mexico 87131). *Optics Letters;* **11**: No. 7, 446-448(Jul 1986).

We predict Stokes-beam divergence, origin, and gain for large-gain Raman amplifiers as functions of pump-beam divergence and pump power in terms of simple analytical expressions. Stokes divergence is found to peak at a pump power twice above threshold. Results are in excellent agreement with exact computer solutions and explain recent experimental observations.

47026 **Monte Carlo molecular dynamics simulations for two-dimensional magnets.** Kawabata, C.; Takeuchi, M.; Bishop, A.R. (Okayama University Computer Center, Okayama 700, Japan). *Journal of Statistical Physics;* **43**: No. 3, 869-872(Jun 1986).

A combined Monte Carlo molecular dynamics simulation technique is used to study the d-italicy-italicn-italica-italicm-italici-italicc-italic structure factor on a square lattice for isotropic Heisenberg and planar classical ferromagnetic spin Hamiltonians.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 47019, 47020, 47026, 47132

47027 **(AD-A—167484/5/XAB) L_1 contraction for systems of conservation laws. Technical summary report.** Patino, J.G.S. (Wisconsin Univ., Madison (USA). Mathematics Research Center). Feb 1986. 11p. (MRC-TSR—2917). NTIS, PC A02/MF A01.

The Cauchy problem for a 2 x 2 system of conservation laws in one dimension is u/sub t/ + (f(u))/sub x/ = 0, x epsilon R, t > 0 u(x,0) = u/sub O/ where u = (u_1, u_2), f = (f1 (u), f/sub (u)/). Such systems of equations usually come from the application of the laws of conservation for physical quantities like mass, momentum and energy, and arise in problems of gas dynamics, elasticity, oil-reservoir simulation and other areas of engineering. The questions of decay and continuous dependence with respect to the initial data are central issues in the study of the problem above. The result proved here rules out the use of certain functionals to study the decay of solutions and is relevant to the issue of L_1 continuity with respect to the data.

47028 **Simulations: A tool for studying quantum condensed matter systems.** Scalapino, D.J. (Department of Physics, University of California, Santa Barbara, California 93106). *Journal of Statistical Physics;* **43**: No. 3, 757-770(Jun 1986).

Quantum Monte Carlo techniques provide a new method for studying the properties of condensed matter systems. A review of this approach and the type of information which it can provide is given.

47029 **Vibrational stabilizability of distributed parameter systems.** Meerkov, S.M. (Illinois Institute of Technology, Chicago). *Journal of Mathematical Analysis and Applications;* **98**: No. 2, 408-418(Feb 1984). Contract AC02-80ER10709.

A condition of vibrational stabilizability for a class of linear partial differential equations is given. An example of vibrational stabilization in a nonlinear situation (Benard instability) is described. 12 references.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 46431, 46432, 46797, 46819

47030 **(AD-A—167804/4/XAB) Current enhancement for hose-unstable electron beams. Memorandum report.** Fernsler, R.F.; Hubbard, R.F.; Hui, B.; Joyce, G.; Lampe, M. (Naval Research Lab., Washington, DC (USA)). 24 Apr 1986. 74p. (NRL-MR—5769). NTIS, PC A04/MF A01.

An electron beam injected into a conducting medium produces inductive electric fields. These fields drive conduction currents which, for stable beams, oppose the beam current and thereby reduce the total (net) current. For unstable beams which undergo large transverse displacements, the inductive field can reverse direction and drive conduction current parallel to the beam current. An analytic and numerical treatment of the latter effect is presented to explain current enhancement as observed for electron beams propagating in gases at pressures above 10 torr.

47031 **(AD-A—167849/9/XAB) Advanced concepts theory: annual report, 1985. Memorandum report, January-December 1985.** (Naval Research Lab., Washington, DC (USA)). 23 Apr 1986. 122p. (NRL-MR—5759). NTIS, PC A06/MF A01.

This report contains the results of theoretical investigations and analyses on issues concerned with the production, interpretation, and understanding of radiation generated from dense hot plasmas. In particular, the radiation from imploding hollow z-pinch plasmas and ion beam-generated plasmas, the influence of radiation on the plasmas morphology, the x-ray conversion efficiency and spectral emission characteristics, dynamics of double gas puff implosions, imploding plasmas as opening switches, and analyses and interpretation of experimental results.

47032 **(CLM-R—250) Calculation of spectral line emission from plasmas. 2. The organisation and use of basic atomic data.** Gordon, H.; Summers, H.P. (UKAEA Culham Lab., Abingdon). Jul 1985. 44p. H.M. Stationery Office, London, price Pound 5.00.

A set of computer codes has been developed for verification display and conversion of atomic cross-section and rate data drawn from the literature. Data for isoelectronic sequence members are prepared as rates in standard forms over standard reduced parameter ranges. Regularities in this 'general z' representative data are exploited to infer rates for arbitrary ions and to generate input for spectral prediction codes. The H, He, Li, Be and Na-like isoelectronic sequences have been incorporated in the database. The operation of the procedures is illustrated.

47033 **(CLM-R—253) FETRAN - a finite element transport modelling package.** Lee-Hsiao; Eastwood, J.W. (UKAEA Culham Lab., Abingdon). Jul 1985. 28p. H.M. Stationery Office, London, price Pound 4.00.

A new moving finite element formulation for equilibrium and transport modelling has been developed. This report describes the implementation of multifluid surface averaged transport using these moving finite elements. The program can be used for axisymmetric toroidal or cylindrical configurations of arbitrary cross section. Test results using INTOR parameters and geometry are presented.

47034 **(CONF-8510266—5) Production of high density plasma by pellet injection in TFTR.** Milora, S.L.; Schmidt, G.L.; Combs, S.K.; Bush, C.E.; Goldston, R.J.; Grek, B.; Hawryluk, R.J.; Johnson, D.; Mansfield, D.; Park, H. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1985. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014027.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

High plasma densities have been produced in ohmic and neutral beam heated discharges on TFTR using a repeating pneumatic pellet injector developed at Oak Ridge National Laboratory (ORNL). Line average plasma densities as high as 1 x 10^{14} cm^{-3} have been attained by injection of five 2.7 mm deuterium pellets Δn/sub e/ = 2 x 10^{14} cm^{-3} over a one-second interval into a stetched neutral beam pulse. Injection of a single large (4 mm) pellet in ohmic discharge has produced highly peaked profiles with nec(o) = 1.8 x 10^{14} cm^{-3}, n/sub e/(0) tau/sub E/(a) = 6.7 x 10^{13} cm^{-3} and n/sub D/(0)Ti(0)tau/sub E/(a) = 8.8 x 10^{13} cm^{-3} sKeV. Global confinement in these discharges approaches 0.45 seconds with a central density decay time of 2 seconds. Based on a neoclassical resistivity model and x-ray pulse-height analysis, zeff is <2 in both ohmic and beam-heated plasmas. The energy confinement properties of intermediate density (n/sub e/ (0) = 1 x 10^{14} cm^{-3}) full beam power (5.7 MW, 80 KVD°) discharge have been studied in detail using the TRANSP code. Although the global energy confinement ($\approx$2 ooms at IP = 2.2 MA) is comparable to gas-fueled discharges, the confinement in the central core is considerably longer and electron heat conduction losses are smaller.

47035 **(CONF-8510266—6) Results of pellet injection into ISX-B.** Schuresko, D.D. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014236.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

Improvements in plasma performance with pellet injection have been achieved in several tokamaks in recent experiments. On the Impurity Study Experiment (ISX-B), an increase in plasma energy by as much as 50%, has been observed following pellet injection. With 1.5-mm pellets, the value for tau/sub E/, the gross energy confinement time determined from β/sub equil/, has peaked at 1.7 times ISX-B scaling for n/sub e/ = 6 x 10^{13} cm^{-3} in both well-gettered and ungettered discharges. Following the peak, in the well-gettered shots tau/sub E/ decays to 1.2 times ISX-B scaling within 50 ms after pellet injection. In the ungettered discharges tau/sub E/ follows the Z-mode scaling that is appropriate to the plasma conditions (P/sub B/ = 1.7 MW, I/sub p/ = 180 kA). Thus, pellet injection in ISX-B shows energy confinement better than that for gas puffing in clean discharges and matches the Z-mode improvement obtained in ungettered discharges. Confinement improvement following pellet injection has also been acheived in smaller (a/sub p/ = 20 cm) plasmas with 1.0 mm diameter pellets. Comparisons of pellet shots which do show this improvement against pellet shots which do not show it was present.

47036 **(DOE/ER/53222—T1) High-beta plasma research. Task 1: high-beta tokamak research. Task 2: high-beta plasma theory. Annual progress report.** Navratil, G.A.; Chu, C.K. (Columbia Univ., New York (USA)). Jul 1986. Contract FG02-86ER53222. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013666.

A very brief summary of work on high-beta plasma theory and high-beta tokamak research is given. (MOW)

47037 **(DOE/ET/53088—2) Institute for Fusion Studies progress report, September 1, 1985-August 31, 1986.** (Texas Univ., Austin (USA). Inst. for Fusion Studies). Aug 1986. Contract FG05-80ET53088. 47p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014687.

A survey of the year's research reveals drift-wave simulation codes being applied to specific experimental issues, detailed profile effects being inferred from turbulence theory, and tokamak operating regimes being calculated from ballooning mode stability analysis. New theoretical approaches have also been developed, including generalized renormalization group methods, three-dimensional code development and the use of field-theoretic concepts, such as spontaneous symmetry breaking, to nonlinear tokamak dynamics. Studies during the past year concern tokamak edge turbulens, self-consistent magnetic stochasticity, and turbulence driven by the ion temperature gradient.

47038 **(DOE/ET/53088—230) Resistive fluid turbulence in diverted tokamaks and the edge transport barrier in H-mode plasmas.** Hahm, T.S.; Diamond, P.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1986. Contract FG05-80ET53088. 34p. (IFSR—230). NTIS, PC A03/MF A01; GPO Dep. File Number DE86014389.

The thermal and particle diffusivities driven by resistive fluid turbulence in diverted tokamak edge plasmas are calculated. Diverted tokamak geometry is characterized by increased global shear near the separatrix and the tendency of field lines to linger near the x-point. For resistive fluid turbulence, the dominant effect is increased global shear, which causes a reduction in the effective step-size of the turbulent diffusion process and corresponding improvements in heat and particle confinement close to the separatrix. Stability of resistive kink modes resonant near separatrix is also ensured by the increased global shear. The relevance of these considerations to the L → H transition and to the edge transport barrier in H-mode plasmas is discussed.

47039 **(DOE/ET/53088—237) Resonances in area-preserving maps.** MacKay, R.S.; Meiss, J.D.; Percival, I.C. (Texas Univ., Austin (USA). Inst. for Fusion Studies). 12 Jun 1986. Contract FG05-80ET53088. 50p. (IFSR—237). NTIS, PC A03/MF A01; GPO Dep. File Number DE86014390.

A resonance for an area-preserving map is a region of the phase space delineated by "partial separatrices", which are curves formed from pieces of stable and unstable manifold of hyperbolic periodic points. Each resonance has a central periodic orbit, which may be elliptic or hyperbolic with reflection. The partial separatrices have turnstiles like the partial barriers formed from cantori. In this paper we show that the areas of the resonances, as well as the turnstile areas, can be obtained from the actions of homoclinic orbits. Numerical results on the scaling of areas of resonances with period and parameter are given. If there are no invariant circles, the resonances appear to fill the phase space completely. Indeed, we prove that the collection of all hyperbolic cantori together with their partial barriers occupies zero area.

47040 **(DOE/ET/53088—239) Two- and three-dimensional magnetoinductive particle codes with guiding center electron motion.** Geary, J.L.; Tajima, T.; Leboeuf, J.N.; Zaidman, E.G.; Han, J.H. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1986. Contract FG05-80ET53088. 37p. (IFSR—239). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014391.

A magnetoinductive (Darwin) particle simulation model developed for examining low frequency plasma behavior with large time steps is presented. Electron motion perpendicular to the magnetic field is treated as massless keeping only the guiding center motion. Electron motion parallel to the magnetic field retains full inertial effects as does the ion motion. This model has been implemented in two and three dimensions. Computational tests of the equilibrium properties of the code are compared with linear theory and the fluctuation dissipation theorem. This code has been applied to the problems of Alfven wave resonance heating and twist-kink modes.

47041 **(DOE/ET/53088—240) Axisymmetric MHD stable sloshing ion distributions.** Berk, H.L.; Dominguez, N.; Roslyakov, G.V. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jul 1986. Contract FG05-80ET53088. 15p. (IFSR—240). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014392.

The MHD stability of a sloshing ion distribution is investigated in a symmetric mirror cell. Fokker-Planck calculations show that stable configurations are possible for ion injection energies that are at least 150 times greater than the electron temperture. Special axial magnetic field profiles are suggested to optimize the favorable MHD properties.

47042 **(DOE/ET/53088—244) Limiter effects on scrape-off layer fluctuations and transport.** Thayer, D.R.; Diamond, P.H.; Wootton, A.J. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Aug 1986. Contract FG05-80ET53088. 11p. (IFSR—244). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014393.

An analysis is presented of scrape-off layer (SOL) fluctuations using a rippling mode or resistivity gradient driven turbulence (RGDT) calculation which incorporates the essential limiter boundary condition. The line-tying effects caused by a simple conducting poloidal limiter can lead to an order of magnitude reduction of the growth rate in the SOL region when parallel thermal conductivity is neglected. The basic effect of the limiter boundary condition can be understood by exploiting the conjugate relation between the parallel and radial mode widths, a consequence of magnetic shear. A reduction of the connection length, due to the limiter, implies an increase in the radial mode width. Assuming a conducting poloidal limiter with a large radial extent, the increased radial mode width causes an increase in thermal conduction damping which is sufficiently large enough so that the rippling mode is rendered stable for typical parallel thermal conductivities. We have also included the destabilizing effect of impurity radiative cooling in the RGDT analysis which leads to an increase of the growth rate, the saturation potential, and the diffusion coefficient by approximately 30% for typical parameters. Additionally, dissipative density gradient driven turbulence (DDGDT) is reconsidered as a viable model of SOL turbulence since it exhibits shorter toroidal mode widths than RGDT; thus, it is less sensitive to the limiter line-tying effect. Satu-

ration level estimates for DDGDT with limiter effects are presented.

47043 **(GA-A—18227) Observation of Ti XXI line radiation in ECH plasmas.** Lee, P.; Lieber, A.J.; Pradhan, A.K.; Yueming, X. (GA Technologies, Inc., San Diego, CA (USA); Colorado Univ., Boulder (USA)). May 1986. Contract FG02-84ER53189;AC03-84ER51044. 20p. (CONF-8511131—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014034.

From 5. international workshop on electron cyclotron emission and electron cyclotron heating; San Diego, CA, USA (9 Nov 1985).

Helium-like titanium line radiation in the x-ray region from 2.60 to 2.64 A has been measured with a high resolution spectrograph ($\lambda/\Delta\lambda > 19{,}000$) during electron cyclotron heating (ECH) experiments on the Doublet III tokamak. The intensity of the resonance line (i.e., $1s^2\ ^1S_0$ - $1s2p\ ^1P_1$) is found to be much more sensitive to the applied ECH power than the intensities of the satellite lines. A qualitative picture which accounts for the observed line intensities is the presence of non-Maxwellian electrons in the ECH plasma.

47044 **(GA-A—18454) Model for divertor function in H-mode onset and proposal for H-mode operation with the island divertor.** Ohyabu, N.; deGrassie, J.S.; Evans, T.E. (GA Technologies, Inc., San Diego, CA (USA)). Jul 1986. Contract AC03-84ER53158. 22p. (CONF-860522—20). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014028.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

We propose that the main function of the divertor configuration in the H-mode mechanism is temporary storage of the effluxing particles for a time longer than the edge energy confinement time. This temporary storage enables the edge temperature to transiently increase above a threshold temperature necessary for the H-mode transition. This model qualitatively explains the superior H-mode regime in mechanically closed poloidal divertors and opens the possibility that the same result could be achieved using the resonant island divertor.

47045 **(IPPCZ—245) On the ponderomotive effects at the lower hybrid waves excitation.** Petrzilka, V.A.; Klima, R.; Pavlo, P. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jun 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703128.

Due to ponderomotive density modulations at the plasma edge the propagation of the lower hybrid primary wave changes. The third spatial harmonic wave is generated. The nonlinearities in question do not modify the directionality of the primary wave. The directionality of the third harmonic wave inside the plasma approximately equals the directionality of the primary wave. The results are important for the high-frequency current drive in tokamaks.

47046 **(IPPJ—729) Collisional relaxation of electron tail distribution.** Yamagiwa, Mitsuru; Okamoto, Masao. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1985. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703120.

Relaxation due to the Coulomb collisions of the electron velocity distribution function with a high energy tail is investigated in detail. In the course of the relaxation, a 'saddle' point can be created in velocity space owing to upsilon^{-3} dependence of the deflection rate and a positive slope or a 'dip' appears in the tail direction. The time evolution of the electron tail is studied analytically. A comparison is made with numerical results by using a Fokker-Planck code. Also discussed is the kinetic instability concerned with the positive slope during the relaxation.

47047 **(IPPJ—733) Computational study on excitation, propagation, and 3Ω sub(D)-heating due to the ion Bernstein wave.** Okada, H.; Abe, H.; Itatani, R.; Ono, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1985. 61p. NTIS (US Sales Only), PC A04/MF A01. File Number DE86703123.

External excitation, propagation, and ion heating on the ion Bernstein wave (IBW) are studied for single ion and two-ion species plasmas using particle simulation. It is found that the value of ω/Ωsub(i) near the antenna position influences the excitation characteristics of the IBW. The wavelength and the group velocity of the propagating IBW agree well with those calculated from the linear dispersion relation. Corresponding to the experiment done at JIPP T-IIU, 3Ω sub(D) heating process in the plasma composed of deuterium-like and hydrogen-like ions is investigated. The wave energy is deposited into the bulk and tail of the deuterium-like ions due to the third harmonic cyclotron resonance and the bulk of the hydrogen-like ions due to the 3/2 Ω sub(H) cyclotron subharmonic resonance, respectively. Also discussed is the possibility that the heating efficiency may not depend on the concentration of the deuterium-like ion in the 3Ω sub(D) heating in the actual tokamak experiment.

47048 **(LA-UR—86-2381) Two-dimensional simulations of magnetically-driven instabilities.** Peterson, D.; Bowers, R.; Greene, A.E.; Brownell, J. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 26p. (CONF-860703—14). NTIS, PC A03/MF A01; GPO Dep. File Number DE86013846.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

A two-dimensional Eulerian MHD code is used to study the evolution of magnetically-driven instabilities in cylindrical geometry. The code incorporates an equation of state, resistivity, and radiative cooling model appropriate for an aluminum plasma. The simulations explore the effects of initial perturbations, electrical resistivity, and radiative cooling on the growth and saturation of the instabilities. Comparisons are made between the 2-D simulations, previous 1-D simulations, and results from the Pioneer experiments of the Los Alamos foil implosion program.

47049 **(LA-UR—86-2419) Liner compression of magnetically-confined, FRC plasmas.** Armstrong, W.T.; Morgan, J.A. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 10p. (CONF-860703—21). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013837.

From 4. international conference on megagauss magnetic-field generation and related topics; Santa Fe, NM, USA (14 Jul 1986).

A survey of fusion gain is made for a liner-compressed Field-Reversed Configuration (FRC), a closed-field-line magnetically confined plasma. The parameter space of initial liner velocity vs initial plasma density is examined for optimum thermonuclear conditions of the FRC at high compression (5 MG confining fields). The O-D survey model, an extension of a previous model, includes alpha heating, contaminant radiation losses and liner flux loss due to liner melting, in addition to plasma particle, energy and flux loss. The effects of speculated instabilities at high densities are discussed. The primary limits on fusion gain are found to be excessive plasma length changes and plasma/liner contact. Final optimized fusion conditions are density $\sim 10^{19}$ cm^{-3}, total temperature $\sim$ 20 keV and plasma energy $\sim$ 1 MJ. These optimized conditions correspond to higher initial density than in previous FRC/liner studies. Discussion of model constraints, experimental implications and a liner trial test are presented.

47050 **(ORNL/TM—9520) Experimental study of equilibrium in a bumpy torus.** Hiroe, S.; Cobble, J.A.; Colchin, R.J.; Chen, G.L.; Connor, K.A.; Goyer, J.R.; Solensten, L. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.). Jun 1986. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014415.

Plasma equilibrium in the ELMO Bumpy Torus (EBT) was studied experimentally by measurements of the electrostatic poten-

tial structure. Before an electron tail population is formed, the electric field is found, roughly speaking, to be in the vertical direction. The appearance of a high-energy electron tail signals the formation of a negative potential well, and the potential contours start to nest. The potential contours are shifted inward with respect to the center of the conducting wall. The electric field between the plasma and the conducting wall forces the plasma inward, balancing the outward expansion force. This force balance provides a horizontal electric field that cancels the concentric radial electric field locally at the separatrix of the potential contour and leads to convective energy loss.

47051 **(ORNL/TM—9703) Effect of electric fields and fluctuations on confinement in a bumpy torus.** Hiroe, S.; Glowienka, J.C.; Hillis, D.L.; Wilgen, J.B.; Chen, G.L.; Cobble, J.A.; El-Nadi, A.M.; Goyer, J.R.; Solensten, L.; Casson, W.H. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014413.

In order to understand the relationships between confinement and space potential (electric field) and between confinement and density fluctuations, plasma parameters in the ELMO Bumpy Torus Scale (EBT-S) have been measured systematically for a wide range of operating conditions. Present EBT plasma parameters do not show a strong dependence on the potential profile, but rather exhibit a correlation with the fluctuations. The plasma pressure profile is found to be consistent with the profile anticipated on the basis of the flute stability criterion for a marginally stable plasma. For a heating power of 100 kW, the stored energy density is found to be restricted to the range between 4.5×10^{13} eV-cm^{-3} and 7×10^{13} eV-cm^{-3}. The lower limit remains constant regardless of heating power and pertains to plasmas lacking an equilibrium and/or stability. The upper limit increases with heating power and is found to result from the onset of instabilities. In between the two limits is a plasma that is in an equilibrium state and is marginally stable. Operational trajectories exist that take the EBT plasma from one limit to the other.

47052 **(RAL—85-022) Calculation of the opacity of hot dense plasmas.** Rose, S.J. (Rutherford Appleton Lab., Chilton (UK)). Mar 1985. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86703126.

A review of the calculation of the radiative opacity of hot dense material is presented. An attempt is made to describe some of the approximations and assumptions implicit in current calculations and to indicate areas in which improvements may be made.

47053 (UCID—20559-Vol.2, pp B.1-B.14) **MINIMARS interim report appendix halo model and computer code.** Santarius, J.F.; Barr, W.L.; Deng, B.Q.; Emmert, G.A. (Univ. of Wisconsin, Madison). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

A tenuous, cool plasma called the halo shields the core plasma in a tandem mirror from neutral gas and impurities. The neutral particles are ionized and then pumped by the halo to the end tanks of the device, since flow of plasma along field lines is much faster than radial flow. Plasma reaching the end tank walls recombines, and the resulting neutral gas is vacuum pumped. The basic geometry of the MINIMARS halo is shown. For halo modeling purposes, the core plasma and cold gas regions may be treated as single radial zones leading to halo source and sink terms. The halo itself is differential into two major radial zones: halo scraper and halo dump. The halo scraper zone is defined by the radial distance required for the ion end plugging potential to drop to the central cell value, and thus have no effect on axial confinement; this distance is typically a sloshing plug ion Larmor diameter. The outer edge of the halo dump zone is defined by the last central cell flux tube to pass through the choke coil. This appendix will summarize the halo model that has been developed for MINIMARS and the methodology used in implementing that model as a computer code.

47054 **(UCLA/PPG—917) User's manual for FENAT: a two-dimensional multigroup diffusion theory Finite Element Neutral Atom Transport code.** Hasan, M.Z. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering). Jul 1986. Contract FG03-86ER52130. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014407.

FENAT solves the two-dimensional energy dependent diffusion equation in Cartesian (X-Y) and cylindrical/toroidal (R-Z) coordinates. The boundary conditions allowed are: vacuum, reflection, albedo and surface source. The energy variable is treated by multigroup method. The resulting multigroup diffusion equation is solved by finite element Galerkin's method with triangular element discretization of the spatial domain. The algebraic matrix equation is solved by the direct method of Crout variation of Gauss' elimination. Dynamic memory allocation has been used so that the maximum problem size is limited by the size of active core storage of the machine. When necessary, the global matrix is stored in a binary disk file. FENAT is particularly suitable for the transport of neutral atoms in fusion plasmas.

47055 **Inner-shell x-ray line spectra of highly ionized titanium, chromium, iron, and nickel and their application to laboratory plasmas.** Lemen, J.R.; Phillips, K.J.H.; Doschek, G.A.; Cowan, R.D. (Mullard Space Science Laboratory, Holmbury St. Mary, Dorking, England). *Journal of Applied Physics;* 60: No. 6, 1960-1973(15 Sep 1986).

The intensities of x-ray lines due to inner-shell 1s-italic-2p-italic transitions in O I-, N I-, and C I-like ions of Ti XV—XVII, Cr XVII-XIX, Fe XIX-XXI, and Ni XXI-XXIII seen in tokamak plasmas are calculated. The lines are assumed to be formed by dielectronic recombination and inner-shell excitation. The present calculations are an extension of previous work for iron alone. The dielectronic contribution for iron was found to be more important, and this is true for the ions of titanium, chromium, and nickel considered here. The dielectronic rates were calculated using a suite of computer programs developed by one of us. The inner-shell contribution was estimated by van Regemorter's formula. The considered ion stages have two or more fine-structure levels in the ground configuration, which gives rise to a density dependence of both dielectronic and collision excitation mechanisms at densities between 10^{11} and 10^{16} cm^{-3}, a range suitable for tokamak plasmas. A means for determining the density of high-temperature plasmas is presented for when no other density diagnostics are available. Finally, the present calculations were applied to the problem of radial ion diffusion in tokamaks. Spectra were calculated by integrating along various lines of sight to simulate what might be observed by an actual spectrometer viewing a tokamak plasma.

47056 **Electrostatic ion probe for tokamak-plasma-edge diagnostic.** da Silva, R.P.; Nascimento, I.C.; da Cruz D.F. Jr.; Hershcovitch, A. (Instituto de Fi-acute-accentsica, Universidade de Sa-tildeo Paulo, C.P. 20516, 01498 Sa-tildeo Paulo, SP, Brazil). *Review of Scientific Instruments;* 57: No. 9, 2205-2209(Sep 1986).

An electrostatic probe for ion temperature and density measurements was built and tested in the scrape-off region of the TBR-1 small tokamak. The main parameters involved in the design and details of the construction of the probe are presented. The electron discrimination and the probe efficiency for ion detection were checked by measuring the probe current as a function of the collector retraction length for a constant voltage. The results for the ion temperature and density obtained from the characteristic curves are discussed and compared with previous measurements.

47057 **Optical and UV/x-ray imaging diagnostics for imploding plasma experiments.** Lee, P.H.Y.; Price, R.H.; Reay, J.; Pecos, J.; Seagrave, J.; McGurn, J.; Cochrane, B.; Anderson, B. (Los Alamos National Laboratory, E-526, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* 57: No. 9, 2227-2229(Sep 1986).

We report on a fast framing camera designed to image imploding foils driven by inductive storage drivers. The camera has several front ends which are disposable, they allow for imaging in either the visible, UV, or x-ray regions; it also has very large dy-

namic range which allows it to record sequences of events where the brightness changes by many orders of magnitude.

47058 **Faraday rotation in a multimode optical fiber in a fast rise-time, high magnetic field.** Wessel, F.J.; Wild, N.C.; Fisher, A.; Rahman, H.U.; Ron, A.; Felber, F.S. (JAYCOR, P. O. Box 85154, San Diego, California 92138-9259). *Review of Scientific Instruments;* **57**: No. 9, 2246-2249(Sep 1986).

A magneto-optic Faraday rotation diagnostic was implemented on a Z-italic-pinch driven flux-compression generator to measure line-averaged, megagauss, axial-magnetic fields up to 1.6 MG with rise times of 30 kG/ns. The axial-magnetic field rotated the plane of polarization of a 2-W argon laser beam in a 0.725-mm-diam, fused silica quartz fiber mounted coaxial with the Z-italic pinch. The rapid rise time and the high radiation environment presented by the Z-italic-pinch plasma caused a high-pressure impulse <100 kbar, to be coupled into the quartz-fiber probe disrupting the polarization-preserving properties of the fiber. The time scale for disruption was characteristic of a shock propagating radially through the fiber to its core. This paper will describe the response of the Faraday diagnostic under these conditions and present a simple model that describes the effects of fiber depolarization that is consistent with previous observations of stress-induced depolarization in optical fibers.

47059 **Comprehensive approach for diagnosing intense single-pulse microwave sources.** Earley, L.M.; Ballard, W.P.; Roose, L.D.; Wharton, C.B. (Microwave Physics Division, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **57**: No. 9, 2283-2293(Sep 1986). Contract AC04-76DP00789.

A comprehensive approach to developing intense pulse microwave diagnostics for measuring the performance of a high-power microwave source is presented. Both conventional and new diagnostic techniques were used. Hence all measurements were made in a redundant fashion allowing small error bars in the measured data. The output power was diagnosed using four methods: two transmitting—receiving systems, two circular waveguide directional couplers, calorimetry, and gaseous breakdown. The operating frequency was measured using three methods: bandpass filters, a heterodyne receiver, and a homodyne receiver. The diagnostics were evaluated by using a 12-vane S-band inverted relativistic magnetron operating at 1 MV, 0.31 T, and 5 kA which reliably produced 3.15-GHz microwaves at powers of approximately 100 MW for pulse lengths variable from 5 to 70 ns. The microwave power pulse had a rise time of approximately 2 ns.

47060 **Relativistic multiregion bounce-averaged Fokker—Planck code for mirror plasmas.** Matsuda, Y.; Stewart, J.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **66**: No. 1, 197-217(Sep 1986). Contract W-7405-ENG-48.

We have developed a unique Fokker—Planck code to study the physics of plasmas that are trapped in magnetic and potential wells of general shape on a collisional time scale. The code was designed primarily to apply to mirror machines, either a simple mirror or a tandem mirror. A plasma confined in a mirror machine generally consists of various groups of particles trapped magnetically and/or electrostatically depending on their energy, magnetic moment, and axial position. Characteristic features of such a plasma are: first, that the bounce times of trapped particles are much shorter than the collision times; and second, that particles trapped in different axial locations can have the same energy and magnetic moment. The former feature allows us to perform bounce-orbit averaging of the kinetic equation, and the latter feature indicates that the distribution function can be multivalued. The code solves a relativistic Fokker—Planck equation averaged over bounce orbits for all the trapped-particle groups. In addition to the Coulomb collision operator, the code includes a synchrotron radiation term, a quasilinear rf diffusion operator, and source and loss terms. The numerical method consists of a mapping technique and a Galerkin finite-element method. Example results using the code for electron-cyclotron resonant heating and neutral beam injection in a tandem mirror are also presented.

47061 **Time-implicit Monte Carlo Collision algorithm for particle-in-cell electron transport models.** Cranfill, C.W.; Brackbill, J.U.; Goldman, S.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* **66**: No. 1, 239-249(Sep 1986).

A time-implicit Monte Carlo collision algorithm has been developed to allow particle-in-cell electron transport models to be applied to arbitrarily collisional systems. The algorithm is formulated for electrons moving in response to electric and magnetic accelerations and subject to collisional drag and scattering due to a background plasma. The correct fluid or streaming transport results are obtained in the respective limits of strongly or weakly collisional systems, and reasonable behavior is produced even for time-steps greatly exceeding the magnetic-gyration and collisional-scattering times.

47062 **3D nonlinear MHD calculations using implicit and explicit time integration schemes:.** Garcia, L.; Hicks, H.R.; Carreras, B.A.; Charlton, L.A.; Holmes, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Computational Physics;* **65**: No. 2, 253-272(Aug 1986). Contract AC05-84OR21400.

A computer code (KITE) that solves a reduced set of magnetohydrodynamic (MHD) equations with diamagnetic and thermal force effects included has been constructed. It can use two different time integration schemes. A mostly-explicit time integration scheme is shown to be efficient for the nonlinear phase of tearing mode turbulance where numerical stability demands a small timestep. However, for linear calculations, or nonlinear ones in which the level of turbulence is low, a mostly-implicit approach is seen to be more efficient. The two numerical schemes yield the same solution. Nonlinear MHD calculations in which the solutions are represented by a finite Fourier series allow one to study the dependence of the nonlinear solution on its permitted harmonic content. It is seen that for the 3-dimensional (3D), nonlinear, tearing mode disruption problem, the refinement of the solution by the addition of more modes leads to further destabilization. This contrasts to the rippling mode problem, in which the addition of modes is stabilizing. For the latter, a finite number of modes yields a converged solution that is a saturated state. This contrasting behavior reflects the basic physical mechanism of the nonlinear interaction in each case and not the particular numerical scheme used for the calculations.

47063 **Trapping of gun-injected plasma by a tokamak.** Leonard, A.W.; Dexter, R.N.; Sprott, J.C. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **57**: No. 3, 333-336(21 Jul 1986).

It is shown that a plasma produced by a Marshall gun can be injected into and trapped by a tokamak plasma. Gun injection raises the line-averaged density and peaks the density profile. Trapping of the gun-injected plasma is explainable in terms of a depolarization current mechanism.

47064 **Self-consistent dynamolike activity in turbulent plasmas.** Bhattacharjee, A.; Hameiri, E. (Department of Applied Physics, Columbia University, New York, New York 10027). *Physical Review Letters;* **57**: No. 2, 206-209(14 Jul 1986).

The evolution of turbulent plasmas is investigated within the framework of resistive magnetohydrodynamics. The functional form of the mean electric field is derived for fluctuations generated by tearing and resistive-interchange modes. It is shown that a bath of such local and global modes in pinches causes toroidal field reversal with finite pressure gradients in the plasma.

47065 **Operation of a quasioptical electron cyclotron maser.** Morse, E.C.; Pyle, R.V. (Lawrence Berkeley Lab., CA). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **3**: No. 3, 1239-1240(May-Jun 1985). Contract AC03-76SF00098.

The electron cyclotron maser, or gyrotron concept, has been developed to produce sources producing 200 kW at 28 GHz continuously, and higher power outputs and frequencies in pulsed mode. These sources have been useful in electron cyclotron reso-

nance heating (ECRH) in magnetically confined fusion devices. However, high frequencies and higher power levels will be required in reactor-grade fusion plasmas, with likely requirements of 1.0 MW or more per source at 140 GHz.

47066 **Renormalization and the breakup of magnetic surfaces.** Greene, J.M. (GA Technologies Inc., San Diego, CA). pp 3-19 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Containment of field lines is a fundamental problem for magnetically controlled fusion. Transport along field lines is much faster than transport across field lines, so that containment of field lines is the first step toward containment of plasma in toroidal devices. Thus this problem has been studied for many years. The purpose of this chapter is to gather these results together and to set them into a fusion context. Sections 2 and 3 discuss the magnetic-containment problem. First, magnetic field lines in axisymmetric systems are treated, and then the effect of nonaxisymmetric perturbations is introduced. Period doubling in a magnetic-field-line context is discussed in Section 4, primarily as an introduction to renormalization in such systems. The breakup of magnetic surfaces is treated in Section 5 and Section 6 contains conclusions.

47067 **Long-time correlations in stochastic systems.** Karney, C.F.F. (Plasma Physics Lab., Princeton Univ., Princeton, NJ). pp 33-42 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

In recent years there has been considerable interest in understanding the motion in Hamiltonian systems when phase space is divided into stochastic and integrable regions. This paper studies one aspect of this problem, namely, the motion of trajectories in the stochastic sea when there is a small island present. The results how that the particle can be stuck close to the island for very long times. For the standard mapping, where accelerator modes are possible, it appears that the mean squared displacement of particles in the stochastic sea may increase faster than linearly with time indicating nondiffusive behavior.

47068 **Magnetic field lines, Hamiltonian mechanics, and symmetries and invariants.** Littlejohn, R.G. (Dept. of Physics, Univ. of California, Los Angeles, CA). pp 43-50 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

It is clear that the theory of maps is still generating a great deal of interest in the plasma-physics community. It seems that many people got interested in map theory in the first place by tracing magnetic field lines around tokamaks and stellarators, so perhaps it is appropriate here to note more about the connection between magnetic field lines and Hamiltonian mechanics. The author tries to give a kind of unified and general treatment of field-line flow as a Hamiltonian system, which should pull all these threads together. It turns out that the way to do this is to modify somewhat both the usual description of magnetic-field-line flow and that of Hamiltonian mechanics. In the case of Hamiltonian mechanics, the modification consists of using noncanonical coordinates in phase space. From a mathematical standpoint, this is a rather simple thing to do. Mathematicians tend to eschew coordinates anyway. but it is a step with a number of useful consequences for plasma physics. In addition to magnetic-field-line flow, the subject of this chapter, there are also guiding-center theory and the subject of gyrokinetic equations, which are clarified by the use of noncanonical coordinates.

47069 **Searching for integrable systems.** Cary, J.R. (Inst. for Fusion Studies, Univ. of Texas, Austin, TX). pp 51-56 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Lack of integrability leads to undesirable consequences in a number of physical systems. The lack of integrability of the magnetic field leads to enhanced particle transport in stellarators and tokamaks with tearing-mode turbulence. Limitations of the luminosity of colliding beams may be due to the onset of stochasticity. Enhanced radial transport in mirror machines caused by the lack of integrability and/or the presence of resonances may be a significant problem in future devices. To improve such systems one needs a systematic method for finding integrable systems. Of course, it is easy to find integrable systems if no restrictions are imposed; textbooks are full of such examples. The problem is to find integrable systems given a set of constraints. An example of this type of problem is that of finding integrable vacuum magnetic fields with rotational transform. The solution to this problem is relevant to the magnetic-confinement program.

47070 **Resonance behavior of the perturbed Toda lattice.** deFainchtein, R.; Reichl, L.E. (Center for Studies in Statistical Mechanics, Univ. of Texas, Austin, TX). pp 65-78 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Numerical data are presented to supplement previous theoretical work on dynamic external-field resonance behavior and chaos in the two-particle Toda lattice.

47071 **Hamilton's principle and the splitting of periodic orbits.** Schmidt, G. (Stevens Inst. of Tech., Hoboken, NJ). pp 57-64 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

It is shown that bifurcation of periodic orbits, and orbit splitting in general, are closely related to the development of new saddle-point directions of the Lagrangian integral I_1. Critical parameter values for orbit-splitting can be found by looking at zeros of the second variation of I_1 over a suitably chosen function space of periodic functions. I_1 is a minimum for unstable periodic orbits and KAM trajectories. The rapid convergence of this method for finding bifurcations is illustrated with the example of a particle in a standing wave field.

47072 **Progress in computing Lyapunov exponents from experimental data.** Wolf, A.; Swift, J. (Dept. of Physics, Univ. of Texas, Austin, TX). pp 111-125 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Of the many diagnostics proposed for deterministic chaotic systems, the spectrum of Lyapunov exponents appears to be the most physically relevant. A well-known technique for computing these exponents for systems defined by sets of differential equations may be reformulated for use with experimental data. Here the authors discuss the calculation of the largest positive exponent with his new technique and compare it to the use of an underlying one-dimensional map to compute the same exponent.

47073 **Kinetic description of a chaotic motion in a classical conservative system with two degrees of freedom.** Petrosky, T.Y. (Center for Studies in Statistical Mechanics, Univ. of Texas, Austin, TX). pp 189-208 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Motion of an elastic pendulum in the vicinity of unperturbed separatrix has been investigated by a kinetic description of nonequilibrium statistical mechanics. New canonical variables of the pendulum, which are well-defined and continuous at the separatrix, have been introduced. A kinetic equation of the Fokker-Planck type for the momentum distribution function has been derived from basic principles in the weak coupling limit. This equation gives the Arnol'd Chirikov diffusion coefficient of the energy of the unperturbed pendulum. In higher-order approximation in a coupling constant, the existence of a logarithmic singularity is pointed out.

47074 **Collisional diffusion in a torus with imperfect magnetic surfaces.** White, R.B. (Plasma Physics Lab., Princeton Univ., Princeton, NJ). pp 209-224 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

A Hamiltonian formulation of the guiding center drift equations is used to investigate the modification of neoclassical diffusion for low collisionality in a toroidal magnetic field with partially de-

stroyed magnetic surfaces. The magnetic field is assumed to be given by the small perturbation of an axisymmetric system. The results are applicable to particle diffusion in realistic confinement systems, midway between axisymmetric and purely stochastic ones. Significant enhancement of electron diffusion over neoclassical rates is found. This increase can be accounted for by the contributions due to the first few island chains in the Fibonacci sequence generated by the zero-order island and by associated stochastic domains.

47075 **Impact of clumps on plasma stability and the nature of turbulence in a saturated state.** Terry, P.W.; Diamond, P.H. (Inst. for Fusion Studies, The Univ. of Texas at Austin, Austin, TX). pp 335-351 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Phase-space density granulations (clumps) are studied using the theory of two-point phase-space density correlation. A novel mechanism of extraction of expansion-free energy is described. This mechanism affects questions pertaining to nonlinear stability. Theories for two-point correlation for the universal mode in a slab geometry with shear and trapped electrons in toroidal geometry are discussed. Results are present that show destabilization of the universal mode and enhancement of the trapped electron growth rate. An analytic formula for the width of the frequency spectrum is obtained. By specifying the collective resonance damping mechanism, the wavenumber spectrum is also calculated. A formula for energy flux illustrates the impact of clumps on transport and energy confinement.

47076 **Statistical physics and chaos in fusion plasmas.** Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984). 361p.

This book examines the statistical properties of nonlinear dynamical systems in relation to plasma confinement. Topics considered include magnetic surfaces, stochastic systems, magnetic field lines, Hamiltonian mechanics, resonance, solitons, fractal basin boundaries, kinetic theory, drift wave turbulence, and clumps in plasma physics.

47077 **Fractal basin boundaries in nonlinear dynamical systems.** Grebogi, C.; McDonald, S.W.; Oh, E. ; Yorke, J.A. (Univ. of Maryland, Coll. Park, MD). pp 127-130 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

The structure of the boundaries separating basins of attraction for different attractors is investigated. To illustrate the possibility of fractal basin boundaries in the simplest possible context, and also to facilitate an analytical calculation, the authors consider a particular two-dimensional noninvertible map. While this example may appear to be somewhat contrived, they emphasize that the phenomena found have also been demonstrated in more-general examples. The fractal basin boundaries described here are nondifferentiable curves.

47078 **Kinetic theory of fluctuations in fluids far from equilibrium.** Cohen, E.G.D.; Kirkpatrick, T.R. (Inst. for Physical Science and Tech., Univ. of Maryland, Coll. Park, MD). pp 171-187 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

An outline is given of the kinetic theory of a convective instability in a fluid, and the density and velocity fluctuations near it. The first convective instability in the Rayleigh-Benard cell is considered. Results are presented for fluids of arbitrary density. The singular behavior of the fluctuations below and above the instability point and their experimental detection are discussed.

47079 **Evolution from coherence to turbulence in plasmas.** Wong, A.Y.; Cheung, P.Y.; Tanikawa, T. (Dept. of Physics, Univ. of California, Los Angeles, CA). pp 131-153 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Highly monochromatic plasma waves are observed to evolve into turbulent spectra with spreads in frequencies and wavenumbers. In the weakly turbulent regime parametric decay and mode-coupling processes account for the spreading in frequency and wavenumber spectra. Certain parametric processes satisfying linear dispersion relations exhibit period doubling as a route to turbulence. The turbulent spectra are a result of sharp spatial inhomogeneities (cavitons) and the interactions between waves trapped inside cavitons. The relationship between caviton collapse and the formation of phase-space granulations is described.

47080 **Coherence in chaos and the Zakharov model.** Doolen, G.D.; DuBois, D.F.; Rose, H.A.; Hafizi, B. (Science Applications Inc., Plasma Research Inst., Boulder, CO). pp 155-167 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

The chaotic nature of "caviton turbulence" is studied in one-dimensional many-Fourier mode numerical simulations of the dissipative Zakharov equations in which the system is driven to modulational instability by energy injection into long-wavelength modes. Just above this instability threshold the system evolves, with hysteresis, into a variety of stable spacetime patterns of cavitons. For stronger driving the system becomes chaotic along various routes; the cavitons remain quite coherent with lifetimes long compared to the shortest Lyapunov time.

47081 **Statistical description of drift wave turbulence.** Horton, W. Jr. (Inst. for Fusion Studies, Univ. of Texas at Austin, Austin, TX). pp 253-271 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Dissipative drift wave fluctuations are studied with the Terry-Horton nonlinear drift wave model. The kω spectral characteristics of the fluctuations are parametrized in terms of the nonlinear frequency ω/subk/ and line width ν/subk/ from computer simulations and the renormalized wave-kinetic equation. The probability distributions of the fluctuations are analyzed to assess the validity of the quasinormal approximation made in the closure of the hierarchy of correlations in statistical turbulence theory.

47082 **Solitons in turbulent flow.** Meiss, J.D. (Inst. for Fusion Studies, The Univ. of Texas, Austin, TX). pp 273-284 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

In this chapter the author discusses the connection between two seemingly dissimilar concepts: turbulence and coherence. Historically, turbulent flow has been characterized by extreme incoherence or randomness, the most successful theoretical treatments assuming quasi-Gaussianity. At the opposite end of the spectrum of fluid motion are laminar flows such as isolated vortices, which they refer to as coherent structures. Perhaps the most coherent structure is the soliton, which maintains its integrity as a manifestation of the integrability of the field theory that describes it.

47083 **Topics in the theory of statistical closure approximations for plasma physics.** Krommes, J.A. (Princeton Univ., Plasma Physics Lab., Princeton, NJ). pp 241-252 of Statistical physics and chaos in fusion plasmas. Horton, C.W.; Reichl, L.E. New York, NY; John Wiley & Sons, Inc. (1984).

Recent advances and directions in the theory of statistical descriptions for plasmas are discussed. It would appear that analytical connections are beginning to be made between statistical closures and the impressive body of recent advances in nonlinear dynamics. Furthermore, the state of the art in numerical computation has advanced to the point where nontrivial tests of such closures as the direct-interaction approximation can be undertaken for situations of interest to applications-oriented plasma physics.

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REFER ALSO TO CITATION(S) 46356, 46366, 46442, 46894, 46895, 46896, 46920, 46921, 46922, 46923, 46924, 46946, 47034, 47035, 47053

47084 **(BNL—38384) Muon sticking factor in muon catalyzed fusion and the other aspect of this fusion process.** Takahashi, H. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 7p. (CONF-860601—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014168.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

The effect of resonance nuclear fusion reaction on the initial muon sticking factor is formulated. The analysis shows that it is very sensitive to the resonance parameter, and the factor calculated, using the molecular wave function obtained by the Diffusion Monte Carlo method, is 0.1 +- 0.01 for the presently evaluated resonance parameter. The analysis of the multistep excitation effect on the reactivation factor shows that the effect is not so large, and the analysis of muonic x-ray spectra of μ^3He from Pμd and dμd fusions is in good agreement with the values measured by Bossy et al.

47085 **(CLM-R—254) Demo tokamak reactor. Aspects of the conceptual design.** Cooke, P.I.H.; Reynolds, P. (UKAEA Culham Lab., Abingdon). Aug 1985. 266p. H.M. Stationery Office, London, price Pound 12.00.

Some of the more important aspects of the design of a demonstration tokamak reactor are discussed with particular emphasis on the design of the tritium breeding blanket and its associated components. Alternative blanket designs employing ceramic and liquid breeding materials are presented. Both conform to the requirements of a commercial reactor in having a global tritium breeding ratio greater than unity and an outlet coolant temperature high enough for efficient electricity generation. Solutions to the problems of heat loading and plasma erosion of the first wall and divertor plates are proposed.

47086 **(CLM-R—255) Development of austenitic stainless steels as low-activity structural materials for fusion reactors.** Bott, A.H.; Pickering, F.B.; Butterworth, G.J. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Aug 1985. 55p. H.M. Stationery Office, London, price Pound 5.00.

A study based on published information has been performed to examine the feasibility of designing low-activity austenitic stainless steels to replace the conventional steels AISI 316, 320 and 321 and the proprietary steel FV548 for use as first wall and blanket materials in a fusion reactor. The alternative compositions have been chosen subject to the condition that the contact gamma ray dose rate associated with the induced radioactivity does not exceed 2.5 x 10^{-5} Gyh^{-1} after a decay period of 100 years. This limit should permit relatively safe handling of discarded components for subsequent recycling. The approach adopted in designing the alternative alloys involved the replacement of the high-activity elements that occur in conventional stainless steels with elements exhibiting low residual dose rates, while at the same time retaining the fully austenitic structure and equivalent transformation characteristics and mechanical properties. The major replacements suggested were Ni by Mn-N combinations, Mo by W, Tb by Ta.

47087 **(CLM-R—258) Bundle divertor. Compositional control and exhaust in tokamak experiments and the NET reactor.** Harbour, P.J.; Johnson, P.C. (UKAEA Culham Lab., Abingdon). Feb 1985. 63p. H.M. Stationery Office, London price Pound 7.00.

The status of knowledge of tokamak discharges with a bundle divertor is described, in particular concerning the effectiveness of a bundle divertor for compositional control and exhaust, first for tokamak experiments, then for the Next European Torus (NET). Magnetic geometry, results from the DITE tokamak experiment, modelling of bundle divertors; assessment of divertor performance, extrapolation from the DITE experiment and from modelling to NET, and comments on reactor bundle divertor designs, are all discussed.

47088 **(CONF-860551—8) Review of tokamak power reactor and blanket designs in the United States.** Baker, C.; Brooks, J.; Ehst, D.; Gohar, Y.; Smith, D.; Sze, D. (Argonne National Lab., IL (USA)). 1986. Contract W-31109-ENG-38. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014593.

From Technical meeting and workshop on fusion reactor design and technology; Yalta, USSR (26 May 1986).

The last major conceptual design study of a tokamak power reactor in the United States was STARFIRE which was carried out in 1979-1980. Since that time US studies have concentrated on engineering test reactors, demonstration reactors, parametric systems studies, scoping studies, and studies of selected critical issues such as pulsed vs. steady-state operation and blanket requirements. During this period, there have been many advancements in tokamak physics and reactor technology, and there has also been a recognition that it is desirable to improve the tokamak concept as a commercial power reactor candidate. During 1984-1985 several organizations participated in the Tokamak Power Systems Study (TPSS) with the objective of developing ideas for improving the tokamak as a power reactor. Also, the US completed a comprehensive Blanket Comparison and Selection Study which formed the basis for further studies on improved blankets for fusion reactors.

47089 **(CONF-860652—20) IPFR: Integrated Pool Fusion Reactor concept.** Sze, D.K. (Argonne National Lab., IL (USA). Fusion Power Program). 1986. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014620.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

The IPFR (Integrated Pool Fusion Reactor) concept is to place a fusion reactor into a pool of molten Flibe. The Flibe will serve the multiple functions of breeding, cooling, shielding, and moderating. Therefore, the only structural material between the superconducting magnets and the plasma is the first wall. The first wall is a stand-alone structure with no coolant connection and is cooled by Flibe at the atmospheric pressure. There is also no need of the primary coolant loop. The design is expected to improve the safety, reliability, and maintainability aspects of the fusion system.

47090 **(CONF-860652—21) Status of fusion reactor blanket design.** Smith, D.L.; Sze, D.K. (Argonne National Lab., IL (USA)). Feb 1986. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014527.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

The recent Blanket Comparison and Selection Study (BCSS), which was a comprehensive evaluation of fusion reactor blanket design and the status of blanket technology, serves as an excellent basis for further development of blanket technology. This study provided an evaluation of over 130 blanket concepts for the reference case of electric power producing, DT fueled reactors in both Tokamak and Tandem Mirror (TMR) configurations. Based on a specific set of reactor operating parameters, the current understanding of materials and blanket technology, and a uniform evaluation methodology developed as part of the study, a limited number of concepts were identified that offer the greatest potential for making fusion an attractive energy source.

47091 **(CONF-8510266—1) Electron beam rocket pellet accelerator.** Foster, C.A.; Menon, M.M. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014230.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

Viewgraphs from the presentation are given. (MOW)

47092 **(CONF-8510266—2) Centrifuge injector development at Oak Ridge National Laboratory.** Foster, C.A. (Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014229.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

Viewgraphs from this presentation are given. The centrifugal injector and its use on the Doublet 3 are described. (MOW)

47093 **(CONF-8510266—3) Operation of the repeating pneumatic injector on TFTR and design of an 8-shot deuterium pellet injector.** Combs, S.K.; Milora, S.L.; Foust, C.R.; Baylor, L.R.; Burris, R.D.; Fisher, P.W.; Lunsford, R.V.; Sparks, D.O.; Stewart, K.A.; Wysor, R.B. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.; Princeton Univ., NJ (USA). Plasma Physics Lab.). 1985. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014222.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

The repeating pneumatic hydrogen pellet injector, which was developed at the Oak Ridge National Laboratory (ORNL), has been installed and operated on the Tokamak Fusion Test Reactor (TFTR). The injector combines high-speed extruder and pneumatic acceleration technologies to propel frozen hydrogen isotope pellets repetitively at high speeds. The pellets are transported to the plasma in an injection line that also serves to minimize the gas loading on the torus; the injection line incorporates a fast shutter valve and two stages of guide tubes with intermediate vacuum pumping stations. A remote, stand-alone control and data acquisition system is used for injector and vacuum system operation. In early pellet fueling experiments on TFTR, the injector has been used to deliver deuterium pellets at speeds ranging from 1.0 to 1.5 km/s into plasma discharges. First, single large (nominal 4-mm-dia) pellets provided high densities in TFTR (1.8×10^{14} cm^{-3} on axis); after conversion to smaller (nominal 2.7-mm-dia) pellets, up to five pellets were injected at 0.25-s intervals into a plasma discharge, giving a line-averaged density of 1×10^{14} cm^{-3}. Operating characteristics and performance of the injector in initial tests on TFTR are presented.

47094 **(CONF-8510266—4) Continuous pellet fueling experiments on D-III.** Foster, C.A.; Milora, S.L.; Attenberger, S.E.; Sengolu, S.; Nagami, M.; Stockdale, R.; Schissel, D.; Wojtowicz, S.; Blau, F.; Fairbanks, E. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.; Japan Atomic Energy Research Inst., Tokyo; GA Technologies, Inc., San Diego, CA (USA)). 1985. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014231.

From International pellet fueling workshop; La Jolla, CA, USA (30 Oct 1985).

A centrifuge pellet injector developed at ORNL was used to continuously fuel beam-heated limiter discharges in D-III. This injector was capable of producing and maintaining a high density neutral beam-heated plasma without auxilary gas fueling. Viewgraphs from the presentation are included.

47095 **(CONF-8605139—3) Minimars maintenance.** Spampinato, P.T. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86011758.

From Minimars review meeting; Toronto, Canada (20 May 1986).

Viewgraphs from the presentation are included. (MOW)

47096 **(DOE/NBM—6012187) Magnetic fusion energy. Disaster operation procedures.** (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86012187.

In a major disaster such as an earthquake, toxic chemical release, or fire, these Disaster Operations Procedures can be used, in combination with good judgment, to minimize the risk of injury to personnel and of property damage in our laboratory, shop, and office areas. These emergency procedures apply to all personnel working within MFE/Zone-11 area including visitors, program contract personnel, and construction contract personnel.

47097 **(EGG-M—01286) Common views of potentially attractive fusion concepts.** Piet, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 7p. (CONF-860652—11). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013489.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

Fusion is viewed through three windows to help determine what constitutes a very attractive fusion concept. These windows are economics, maintenance and reliability, and safety and environment. Achievement of many desired features cannot yet be quantified. Although these differing perspectives can lead to some conflicting desires, five common desired features are apparent - (a) minimum failure rates, (b) minimum failure effects, (c) minimum complexity, (d) minimum short-term radioactivity, and (e) maximum mass power density. Some innovative fusion concepts are briefly examined in the light of these commonalities.

47098 **(GA-A—18455) Experiments to test an intra-island scoop limiter on TEXT.** Evans, T.E.; deGrassie, J.S.; Jackson, G.L.; Ohyabu, N.; Karger, F.; Haas, G. (GA Technologies, Inc., San Diego, CA (USA); Texas Univ., Austin (USA). Fusion Research Center; Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1986. Contract AC03-84ER53158. 24p. (CONF-860522—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE86014030.

From 7. international conference on plasma surface interactions in controlled fusion devices; Princeton, NJ, USA (5 May 1986).

An instrumented scoop limiter probe is being operated on TEXT to test the concept of limiter cooling and improved particle removal efficiencies using an externally-applied resonant magnetic field perturbation (the resonant helical divertor concept). Cooling of the limiter face has been demonstrated for limiter positions ranging from γ/sub L/ = 29.0 cm inward to γ/sub L/ = 25.5 cm (the TEXT primary poloidal hoop limiter radius γ/sub a/ = 27.0 cm). Pressure rises in the limiter throat of approximately 40% are observed under optimized conditions. Interchangeable limiter heads with thicknesses of 1.0 cm and 0.3 cm have been used to examine particle ducting into the scoop aperture. Experimental results are discussed along with observations of the limiter floating potential, H/sub α/ recycling emissions, pressure measurements, and edge density and temperature measurements.

47099 **(IPPJ-DT—115) Study meeting on 'criteria for materials of nuclear fusion reactors'.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1984. 103p. (In Japanese). (CONF-8403241—). NTIS (US Sales Only), PC A06/MF A01. File Number DE86703134.

From Study meeting on criteria for materials of nuclear fusion reactors; Nagoya, Japan (1 Mar 1984).

This study meeting was held on March 1 and 2, 1984, at the Institute of Plasma Physics, Nagoya University. Recently, the problems required for the materials of nuclear fusion reactors have become considerably clear. The problem of the high concentration damage due to 14 MeV neutrons and the problem of surface materials have been well known from the beginning, but moreover, the radioactivation of materials, the problem of safety, and the feasibility of remote operation related to it have become urgent problems. Besides, the plan of large scale facilities as the means of promoting research is one of the important themes. The research on materials must take part in the whole technological problems which enable the construction of actual nuclear fusion devices. This study meeting was held as a part of the R project of the Institute of Plasma Physics, Nagoya University, but it aimed at grasping the present status and discussing the future perspective of the materials of nuclear fusion reactors, and examining the criteria for nuclear fusion materials. The gists of 23 lectures presented at the meeting are collected in this report.

47100 **(LA-UR—86-2299) COVFILS-2: neutron data and covariances for sensitivity and uncertainty analysis.** Muir, D.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 6p. (CONF-860652—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013858.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

We have prepared a new, fusion-oriented library of multigroup neutron cross sections, scattering matrices, and covariances (uncertainties and correlations) using modules of the NJOY nuclear data processing system. This 74-group library, called COVFILS-2, was produced specifically for use in the sensitivity and uncertainty analysis of fusion-relevant integral experiments. The 14 materials included in the first version of COVFILS-2 are H, ^{6}Li, ^{7}Li, Be, C, N, O, Na, Al, Si, Cr, Fe, Ni, and Pb.

47101 **(LA-UR—86-2636) Heavy-ion fusion reactor concepts, requirements and attractive features.** Pendergass, J.H. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 10p. (CONF-860510—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013821.

From Symposium on heavy ion fusion; Washington, DC, USA (27 May 1986).

Four generic reactor-plant concepts were included in the Heavy Ion Fusion Systems Assessment to provide a wide range of pulse-repetition-rate/target-yield capability - 1 to 20 Hz/150 to 3000 MJ. This permitted exploration of the impact on heavy-ion fusion cost of electricity (COE) of the repetition-rate and efficiency advantages of induction linacs relative to other ICF drivers. Minimum COE results are encouraging - from 55 to 75 mills/kWh for 1000-MWe plants to <45 mills/kWh for 1500 MWe. HIF with induction-linac drivers can compete using more than one reactor plant concept. Minimum COE corresponds to reactor repetition rates < 10 Hz for 1000-MWe, one-reactor plants. Contrary to pre-HIFSA expectations, large pulse repetition rates are optimum only for very large plants. COE's are within 5% of minimum COE over wide ranges of repetition rate and target yield. Cost or technological problems is one part of plant parameter space need not be fatal for HIF because of the large low-COE parameter space.

47102 **(NBSIR—86-3050) Materials studies for magnetic fusion energy applications at low temperatures - IX.** Reed, R.P. (ed.). (National Bureau of Standards, Boulder, CO (USA). Fracture and Deformation Div.). May 1986. 326p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE86014006.

This report contains results of a research program to produce material property data that will facilitate design and development of cryogenic structures for the superconducting magnets of magnetic fusion energy power plants and prototypes. Nineteen technical papers are presented under four headings reflecting the main program areas: Welding, Nonmetallics, Structural Alloys, and Technology Transfer. Abstracts for each of these papers have been prepared.

47103 (NEANDC(J)—117/U, pp 3-14) **Review on nuclear data for fusion reactors.** Kanda, Y. (Kyushu Univ., Kasuga, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Present status of fusion nuclear data is briefly reviewed taking account of the relation among differential experiment, evaluation, and integral experiment. It is emphasized that covariances should be introduced to the comparison between calculations and experiments and that model calculation should be effectively used in the evaluation of the fusion nuclear data. Preparation of reference data set is proposed to improve model calculation for neutronics.

47104 (NEANDC(J)—117/U, pp 15-31) **Status of JENDL-3PR1 and 3PR2.** Asami, T. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

The compilation of JENDL-3PR1 and -3PR2 was made urgently to use their evaluated data for analyses of integral experiments for fusion neutronics. These files include the evaluated data for eight nuclides important for fusion neutronics, i.e., ^{6}Li, ^{7}Li, ^{9}Be, ^{12}C, ^{16}O, Cr, Fe and Ni. The data for these nuclides except for ^{16}O were obtained by revising the JENDL-2 ones temporarily and the ^{16}O data were evaluated newly. The outline and special features of these evaluated data are described briefly.

47105 (NEANDC(J)—117/U, pp 52-56) **Nuclear data and integral experiments required for fusion reactor nuclear design.** Seki, Y. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Nuclear data required for the nuclear design of fusion reactors are described very briefly. The ^{7}Li cross sections in the GICX40 library which had been derived from ENDF/B-3 were replaced by those derived from JENDL-3PR1. The effects of the replacement on tritium breeding ratios of two types of blankets are shown. Integral experiments useful for the validation of the data and methods used in the nuclear design are described.

47106 (NEANDC(J)—117/U, pp 57-67) **High tritium breeding ratio (TRB) blanket concept and requirements for nuclear data relating to TBR.** Maki, K. (Hitachi Ltd., Ibaraki, Japan). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

Significance of developing a blanket having a sufficiently larger tritium breeding ratio (TBR) than 1.0 is discussed. For this purpose, a high TBR blanket with a front breeder zone just before the multiplier is introduced together with conventional blankets. From discussion of TBR characteristics in these blankets, the necessity of improving on nuclear data, i.e. reducing uncertainties is presented as follows; σ/sub s/, σ/sub np/ and σ/sub nα/ of structural and coolant materials, and σ/sub n2n/ of the multiplier at higher energies above several MeV, and σ/sub nγ/ of these materials and σ/sub nαT/ of ^{6}Li at energies from several hundred keV to thermal energy.

47107 (NEANDC(J)—117/U, pp 183-195) **Fusion blanket engineering benchmark experiment.** Nakamura, T. (Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken). Mar 1986. Information Div., Dept. of Technical Information, JAERI, Tokai-mura, Naka-jur, Ibaraki-ken, Japan. File Number TI86901123. (JAERI-M—86-029; INDC(JPN)—103/L; CONF-8507114—).

From Specialists' meeting on nuclear data for fusion neutronics; Tokai, Japan (23 Jul 1985).

In Fusion Blanket Engineering Benchmark Experiments at the FNS, simplified systems of composite configurations are deliberately chosen, experimental data are acquired in parametric way, then, the comparisons are made with various calculation results to point out problems associated with the heterogeneous structure and to assess the overall accuracies of the nuclear calculations. The accumulation of the information thus obtained serves to reduce the uncertainties in interpreting the TBR and other neutronic quantities in the conceptual reactor design, performing a complementary role to the basic benchmark experiments. This program has been selected as one of the joint activities between JAERI and US DOE.

47108 **(ORNL/FEDC—86/3) Multiplex tokamak power plant.** Dabiri, A.E. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). Jul 1986. Contract AC05-84OR21400. 38p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014400.

The concept of multiplexing for a fusion power core as an option for producing power is explored. Superconducting, as well

as normal magnet, coils in either first or second stability regimes are considered. The results show that multiplex plants with superconducting magnets operating in the second stability regime could be competitive with the single-unit plants in some unit sizes. The key issues that impact the expected benefits of multiplexing must be investigated further. These are factory fabrication, economy of scale, the extent of equipment sharing, inherent safety, maintainability, and utility load management.

47109 **(ORNL/FEDC—86/4) Tokamak System Code Version II.** Reid, R.L. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). Aug 1986. Contract AC05-84OR21400. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE86014399.

The Tokamak System Code has been revised to more accurately model the plasma physics, the poloidal field coil/magnetohydrodynamic (MHD) systems, and the toroidal field (TF) coil system. The plasma physics model now uses a two-fluid representation of the electron-ion power balance and has a wide selection of confinement scalings. The poloidal field coil subroutine was upgraded by incorporating a version of the Fusion Engineering Design Center MHD code. The TF coil subroutine was revised to more accurately model copper TF coil versions of tokamaks.

47110 **(ORNL/TM—9992) Helium mass flow measurement in the International Fusion Superconducting Magnet Test Facility.** Baylor, L.R. (Oak Ridge National Lab., TN (USA). Fusion Energy Div.). Aug 1986. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; GPO Dep. File Number DE86014409.

The measurement of helium mass flow in the International Fusion Superconducting Magnet Test Facility (IFSMTF) is an important aspect in the operation of the facility's cryogenic system. Data interpretation methods that lead to inaccurate results can cause severe difficulty in controlling the experimental superconducting coils being tested in the facility. This technical memorandum documents the methods of helium mass flow measurement used in the IFSMTF for all participants of the Large Coil Program and for other cryogenic experimentalists needing information on mass flow measurements. Examples of experimental data taken and calculations made are included to illustrate the applicability of the methods used.

47111 **(PPLK—4) Annual review of Plasma Physics Laboratory, Kyoto University, April, 1983.** (Kyoto Univ., Uji (Japan). Plasma Physics Lab.). Apr 1983. 130p. NTIS (US Sales Only), PC A07/MF A01. File Number DE86703133.

The devices for additionally heating joule-heated plasma in the Heliotron E, such as electron cyclotron resonance heating and neutral beam injection, were in operation in 1982. In the ECRH experiment the microwaves of 200 kW at 28 GHz were generated by a gyrotron, but the pulse width was extended from 10 ms to 40 ms this year. By this, a currentless plasma of Te-1 keV was achieved. In the NB1 experiment the neutral beam of about 1.5 MW was injected into joule-heated plasma, and the plasma of Ti(O)-950 eV, Te(O)-800 eV and Ne = 3 x 10^{19}/m^3 was attained. The first experiment to inject neutral beam into ECRH currentless plasma was carried out. By this method the density of the plasma increased as well as the ion temperature and electron temperature. As to the theory, a critical beta was calculated by using stellarator expansion, which should be 3 to 7% in the Heliotron E. Two gyrotrons of 200 kW at 53 GHz each and an ion cyclotron resonance heating equipment of 1.5 MW at 26.7 MHz are prepared. As to the reactor study, the design of Heliotron H in the first phase was completed. The location of impurity sources in NB1 ion sources and beam lines was found.

47112 **(SAND—86-1706C) Progress in light ion beam fusion research on PBFA II.** Cook, D.L.; Allshouse, G.O.; Bailey, J.; Barr, G.W.; Boyes, J.D.; Burgess, E.L.; Boyer, W.B.; Cap, J.S.; Coats, R.S.; Dreike, P.L.;. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 10p. (CONF-860710—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014370.

From 13. annual plasma physics conference; Oxford, UK (2 Jul 1986).

We are conducting pulsed power characterization experiments on PBFA II aimed at bringing the accelerator to a fully operational state. During this period we are acquiring substantial amounts of data on accelerator performance and initial data on ion diode performance. Next year, we will begin to concentrate on ion beam generation and focusing, with the goal of reaching the levels of beam energy, power, and intensity needed for ignition scaling experiments. Once the beam has been focused, initial target experiments will begin. The far term plans for PBFA II now include development and demonstration of the pulse-shaping techniques which are necessary for high-gain target compressions. Following a modification of the accelerator which will probably include an "extraction" ion diode, a 4- to 5-meter plasma channel for beam bunching during propagation, and a target chamber located beneath the accelerator, temporally-shaped ion beam pulses will be available for pulse-shaped target experiments.

47113 **(UCID—20234) Flibe/He concept.** Moir, R. (Lawrence Livermore National Lab., CA (USA)). Oct 1984. Contract W-7405-ENG-48. 12p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014403.

As in all fusion blankets many physics and engineering parameters influence material temperature and heat transfer to the coolant. In performing thermal-hydraulics calculations for the Flibe/He concept, the first wall was assumed to be 5 MW/m^2. The coolant is helium with a nominal pressure of 50 atmospheres. To eliminate "pinch-point" steam generator problems a helium inlet temperature of 275°C was specified. Helium outlet temperature was limited to 500°C in order to not have structural HT-9 steel above 550°C. That limit for HT-9 has been imposed due to neutron damage effects which seriously detract from its ductility and strength above that temperature. Volumetric heating calculations at various blanket locations are given.

47114 (UCID—20559-Vol.2, pp A.1-A.164) **Fusion engineering design center appendix to the MINIMARS interim report.** Nelson, W.D.; Blackfield, D.T.; Bussell, G.T.; Gorker, G.E.; Keeton, D.C.; Lousteau, D.C.; Spampinato, P.T.; Taylor, G.E.; Yugo, J.J. (Oak Ridge National Lab., TN). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

Personnel at the Fusion Engineering Design Center (FEDC) have been contributing partners in the mirror program for the past four years. These years have involved work on machines such as the Technology Demonstration Facility (TDF), the MFTF-Alpha+T (an upgrade of the MFTF-B), and the Fusion Power Demonstration (FPD) device. This year, the effort was directed toward the MINIMARS design. The principle role for the FEDC has been to integrate the various concepts into an overall, integrated engineering design. The present design is not, at this time in the study effort, a self-consistent design, but it will be by the end of the study. In addition to integrating the design, FEDC has played a major innovation and design role in electrical systems, plasma heating systems, maintenance, availability, fueling, facilities, and reactor components. FEDC has also played a major role in developing an optimization code for tandem mirrors, which has been used to establish baseline MINIMARS physics and engineering parameters and to perform many physics and engineering trade studies. In addition, the Design Center has supplied cost estimates for the MINIMARS reactor. This appendix contains two kinds of material. The first is an expansion of the material found in the FY 1985 MINIMARS summary report and the second is a description of background studies performed during the year that led to the concepts and conclusions described in the summary report.

47115 (UCID—20559-Vol.2, pp C.1-C.14) **Appendix C: safety design rationale.** Ghose, S. (Bechtel Group Inc., San Francisco, CA). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

A brief discussion of the rationale for safety design of fusion plants is presented in the main text. Further detail safety considerations are presented in this appendix in the form of charts and tables. The author present some of the major safety criteria and other criteria used in blanket selection here.

47116 (UCID—20559-Vol.2, pp D.1-D.14) **Appendix for blanket - University of Wisconsin: tritium issues.** Wittenberg, L.J. (Univ. of Wisconsin, Madison). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

The selection of the liquid metal alloys, $Li_{17}Pb_{83}$, as the tritium breeder with helium serving as the heat transfer fluid suggests two alternative techniques for the removal of tritium from the breeder. The low solubility of tritium in this liquid breeder requires only a simple vacuum degassing technique for tritium removal. Because of this high tritium partial pressure, tritium removal in the present design could potentially be achieved by either (a) slow circulation of the liquid LiPb alloy to an external degassing system, or (b) noncirculation of the liquid breeder so that the tritium permeates through the walls of the coolant tubes into the circulating helium for subsequent recovery. Both of these techniques were investigated with special attention given to the resultant tritium inventories in the liquid breeder and the helium system, and the potential for tritium permeation at the steam generator (SG).

47117 (UCID—20559-Vol.2, pp E.1-E.30) **Activation product transport in a FLiBe-vanadium alloy-HT9 system.** Klein, A.C.; Sze, D.K. (Oregon State Univ., Corvallis). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

An assessment is made of the gamma radiation hazards likely to be found around a fusion reactor heat transfer and tritium breeding loop which employs a vanadium alloy for the blanket and first wall structure and the ferritic-steel HT9 for the remainder of the loop. The coolant/tritium breeding fluid is the molten metallic salt FliBe. Since the radiation levels near the primary loop components are found to be less than 100 mR/hr 3-5 days after shutdown after three years of continuous full power operation, limited hands-on maintenance could be allowed. The very short half-lives of the predominant corrosion products make this result possible and make such a system very attractive.

47118 (UCID—20559-Vol.2, pp F.1-F.36) **Halo scraper/ direct converter system study.** Luzzi, T.; Clarkson, I.; Barr, W.; Neef, W. Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

During the first year of the LLNL Minimars program, a system study was undertaken to determine the most efficient method for recovery of the end cell thermal energy. The goal of the study was to recovery energy at the highest possible coolant temperature and therefore at the highest thermal efficiency. Two types of coolant were considered, water and gaseous helium. In a system study where the goal is to recover maximum thermal power in an economically designed device, it is necessary to place constraints on the design. The four constraints for the direct converter are somewhat conflicting in that a particularly design solution satisfying one may lead to an unacceptable solution for another. The final design choice must be a compromise that satisfies all the constraints.

47119 (UCID—20559-Vol.2, pp G.1-G.12) **Appendix G. Heat transport and power conversion.** Ghose, S. (Bechtel Group Inc., San Francisco, CA). Dec 1985. NTIS, PC A13/MF A01. File Number DE86006102.

In MINIMARS conceptual design: Report I. Volume 2.

A brief description of the heat transport system is given in the main text. The following aspects of heat transport are discussed in this appendix: after heat removal, integrated primary-coolant piping, and number of steam generators.

47120 (UCRL—52000-86-4/5) **Energy and Technology Review, April-May 1986.** Cabayan, H.S.; Coleman, L.W.; Adye, P.; Clements, W.; de Vore, L.; Hendry, D.P.; Kirvel, R.D.; O'Neal, E.M.; Taft, S.O. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE86014244.

Some technical challenges were solved to construct the large-aperture frequency-conversion arrays for NOVA. Among these are precision machining of potassium dihydrogen phosphate crystals, precise crystal orientation, and reflection coatings. New glass-melting techniques are reported that can produce the inclusion-free glass that will be used to replace the glass disks now in the NOVA laser amplifiers. A system for detecting microscopic inclusions in optical glass is described. A second target chamber has been added that uses two beams of the NOVA laser. Recent achievements in soft x-ray lasing are discussed. The Laser Experiments Analysis Facility (LEAF) is described briefly. The Cascade reactor, a concept for producing electricity from inertial confinement fusion, is discussed. (LEW)

47121 (UCRL—94084) **Helium-cooled, FLiBe-breeder, beryllium-multiplier blanket for MINIMARS.** Moir, R.W.; Lee, J.D. (Lawrence Livermore National Lab., CA (USA)). Jun 1986. Contract W-7405-ENG-48. 7p. (CONF-860652—16). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013898.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

We adapted the helium-cooled, FLiBe-breeder blanket to the commercial tandem-mirror fusion-reactor design, MINIMARS. Vanadium was used to achieve high performance from the high-energy-release neutron-capture reactions and from the high-temperature operation permitted by the refractory property of the material, which increases the conversion efficiency and decreases the helium-pumping power. Although this blanket had the highest performance among the MINIMARS blankets designs, measured by Mn/sub th/ (blanket energy multiplication times thermal conversion efficiency), it had a cost of electricity (COE) 18% higher than the University of Wisconsin (UW) blanket design (42.5 vs 35.9 mills/kW.h). This increased cost was due to using higher-cost blanket materials (beryllium and vanadium) and a thicker blanket, which resulted in higher-cost central-cell magnets and the need for more blanket materials. Apparently, the high efficiency does not substantially affect the COE. Therefore, in the future, we recommend lowering the helium temperature so that ferritic steel can be used. This will result in a lower-cost blanket, which may compensate for the lower performance resulting from lower efficiency.

47122 (UCRL—94115) **TIBER II: an upgraded tokamak igntion/burn experimental reactor.** Henning, C.D.; Logan, B.G.; Perkins, L.J.; Barr, W.L.; Bulmer, R.H.; Devoto, R.S.; Doggett, J.N.; Fenslermacher, M.; Johnson, B.M.; Lee, J.D. (Lawrence Livermore National Lab., CA (USA); TRW, Inc., Redondo Beach, CA (USA); Wisconsin Univ., Madison (USA)). 5 Jun 1986. Contract W-7405-ENG-48. 10p. (CONF-860652—15). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013899.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

We are disIgning a minimum-size Tokamak ignition/Burn Reactor (TIBER II). This design incorporates physics requirements, neutron wall loading and fluence parameters that will make it compatible with a nuclear testing mission. Reactor relevant physics will be tested by using current drive and steady-state operation. Although the design accommodates several current drive options, including neutral beams, the base case uses a combination of lower hybrid and electron-cyclotron radio frequency power. Minimum neutron shielding, compact structures, high magnet-current densities, and remotely maintainable vacuum seals, all contribute to the compact size.

47123 (UCRL—94693) **In-situ MHD energy conversion for fusion.** Campbell, R.B.; Logan, B.G.; Hoffman, M.A. (TRW, Inc., Redondo Beach, CA (USA); Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). Jun 1986. Contract W-7405-ENG-48. 11p. (CONF-860652—18). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013901.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

An advanced concept, in-situ MHD conversion, is described for converting fusion energy to electricity. Considerable cost savings can be realized because of the conversion of thermal energy to electricity achieved in the blanket by means of magnetohydrodynamic (MHD) generators. The external disk generator, also described,

is another application of the MHD idea, which may have certain advantages over the in-situ scheme for advanced-fuel tokamaks. The feature that makes these schemes fusion-specific is the novel use of the electro-magnetic radiation naturally emitted by the plasma. The synchrotron radiation can be used either to heat the nonequilibrium MHD plasma, or possibly improve its stability. A Rankine cycle with cesium-seeded mercury as a working fluid is used in either case. Performance predictions by a quasi-one-dimensional model are presented. An experiment to determine the effect of microwave radiation on channel performance is planned.

47124 **(UCRL—94815) Numerical study of the mode selection in response spectrum analysis-condensed version.** Ng, D.S. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1986. Contract W-7405-ENG-48. 18p. (CONF-8609119—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86013023.

From Building design and construction conference; Beijing, China (1 Sep 1986).

For quality assurance of the dynamic response spectrum analysis, the Nuclear Regulatory Commission (NRC) recommends retaining all modes below the cutoff frequency at which the spectral acceleration (S/sub a/) returns to the peak zero period acceleration (ZPA). It also suggests that modes accounting for at least 90 percent of the structural masses be included in the analysis. A simple frame-type structure is generated as a baseline frame. Then groups of oscillators representing substructure are added onto the frame to study substructure behavior. A base case is established for each frame by including the specific number of modes used. The tests are conducted by incrementing the number of modes in the response spectrum analyses starting with one mode. The structural response of each modal increment is compared with the base case to identify the efficiency of mode selection method. All three methods are then applied to the MFTF-B Axicell Vacuum Vessel. The responses in critical components of the vessel, such as hangers and foundations, will be analyzed to confirm the accuracy of the selected method.

47125 **Fast-opening magnetic valve for high-pressure gas injection and applications to hydrogen pellet fueling systems.** Milora, S.L.; Combs, S.K.; Foust, C.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **57**: No. 9, 2356-2358(Sep 1986). Contract AC05-84OR21400.

A fast, magnetically driven gas valve and its application to pneumatic-based solid hydrogen pellet injectors are described. The valve, which is equipped with a polyimide stem tip (hard seal) and a 5-mm-diam orifice, can open against working pressures up to 140 bar (2000 psi). Other unique features of this design include temperature- and radiation-resistant seals, a programmable output pressure pulse, and repetitive operation in excess of 20 Hz. A prototype valve has been used to propel frozen hydrogen isotope pellets to speeds of up to 1900 m/s.

47126 **Measurement and analysis of near-classical thermal transport in one-micron laser-irradiated spherical plasmas.** Hauer, A.; Mead, W.C.; Willi, O.; Kilkenny, J.D.; Bradley, D.K.; Tabatabaei, S.D.; Hooker, C. (Los Alamos National Lab., NM). *Physical Review Letters;* **53**: No. 27, 2563-2566(31 Dec 1984).

Solid spherical layered targets have been uniformly illuminated at irradiances of 10^{14} to 10^{15} W/cm^2. Extensive diagnostics including time-resolved x-ray emission and optical probing were used to determine the plasma ablation rate and the plasma blowoff conditions. Comparisons with hydrodynamic simulations show that the thermal conduction is well characterized by a flux limit f/sub e/ = 0.08 +/- 0.02, with a steep temperature gradient. The steepness of the heat front was confirmed with time-resolved spectroscopy. 13 references, 5 figures.

99 GENERAL AND MISCELLANEOUS

47127 **(DOE/MA—0240) Report to Congress on the small business program of the Department of Energy, FY 1985.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Small and Disadvantaged Business Utilization). Jun 1986. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014326.

This Report to Congress covers twenty-seven organizational components of the Department including seven Assistant Secretaries, the eight Operations Offices, the five power administrations, two other administrations and several significant offices. The Act excludes military applications of nuclear energy.

47128 **(LA-UR—86-1481) Can the US afford a lunar base.** Keaton, P.W. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 11p. (CONF-860179—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86010207.

From Workshop on astronomical observations from a lunar base; Houston, TX, USA (10 Jan 1986).

Establishing a lunar base will require steady funding for a decade or two. The question addressed here is whether such a large space project is affordable at this time. The relevant facts and methodology are presented so that the reader may formulate independent answers. It is shown that a permanent lunar base can be financed without increasing NASA's historical budgetary trends.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 45598, 45599, 46395, 46884, 46889

47129 **(AD-A—167620/4/XAB) Distributed computing for signal processing: modeling of asynchronous parallel computation. Appendix B. Design of the operating system for the PASM parallel-processing system. Final report.** Tuomenoksa, D.L. (Purdue Univ., Lafayette, IN (USA)). May 1983. 347p. NTIS, PC A15/MF A01.

As a result of advances in microcomputer technology, it is now feasible to build large-scale parallel-processing systems capable of performing image-processing tasks more rapidly than previously possible. Such parallel-processing systems add levels of complexity for both the operating system and the application software. They impose constraints that make a direct transplantation of conventional (multiprogrammed) operating systems extremely inefficient (Bae80). This thesis considers the design of PASMOS, a distributed operating system for the PASM parallel-processing system. PASM is a reconfigurable multimicrocomputer system which is being designed at Purdue University for image-processing and pattern-recognition applications. The special-purpose nature of PASM has been exploited in the design of PASMOS. PASMOS has a hierarchical structure and is distributed throughout the hardware components of PASM. It utilizes the PASM hardware to create an execution environment (virtual machine) for parallel processing tasks. Facilities provided by PASMOS include those for task management and scheduling, memory management, user interaction, process communication and synchronization, and protection. The general performance of the PASM system was examined both analytically and via simulation.

47130 **(AD-A—167621/2/XAB) Distributed computing for signal processing: modeling of asynchronous parallel computation. Appendix C. Fault-tolerant interconnection networks and image-processing applications for the PASM parallel processing systems. Final report.** Adams, G.B. (Purdue Univ., Lafayette, IN (USA)). Dec 1984. 371p. NTIS, PC A16/MF A01.

The demand for very-high-speed data processing coupled with falling hardware costs has made large-scale parallel and distributed computer systems both desirable and feasible. Two modes of parallel processing are single-instruction stream-multiple data stream (SIMD) and multiple instruction stream - multiple data stream (MIMD). PASM, a partitionable SIMD/MIMD system, is a reconfigurable multimicroprocessor system being designed for

image processing and pattern recognition. An important component of these systems is the interconnection network, the mechanism for communication among the computation nodes and memories. Assuring high reliability for such complex systems is a significant task. Thus, a crucial practical aspect of an interconnection network is fault tolerance. In answer to this need, the Extra Stage Cube (ESC), a fault-tolerant, multistage cube-type interconnection network, is defined. The fault tolerance of the ESC is explored for both single and multiple faults, routing tags are defined, and consideration is given to permuting data and partitioning the ESC in the presence of faults. The ESC is compared with other fault-tolerant multistage networks. Finally, reliability of the ESC and an enhanced version of it are investigated.

47131 **(AD-A—167622/0/XAB) Distributed computing for signal processing: modeling of asynchronous parallel computation. Appendix G. On the design and modeling of special-purpose parallel-processing systems. Final report.** Smith, B.W. (Purdue Univ., Lafayette, IN (USA)). May 1985. 317p. NTIS, PC A14/MF A01.

As the capabilities of computing machinery grow, so does the diverse variety of their applications. The feasibility of many approaches to these applications depends solely upon the existence of computing machinery capable of performing these tasks within a given time constraint. Because the majority of the available computing machinery is general-purpose in nature, tasks that do not require purpose facilities, but that do require high throughput, are condemned to execution on expensive general-purpose hardware. This research describes several tasks that require fast computing machinery. These tasks do not require general-purpose facilities in the sense that the computing machinery used will only perform a fixed set of tasks. Some of the tasks are simple in nature, but are required to execute on very-large data sets. Other tasks are computationally intensive in addition to possibly involving large data sets. Both simple and complex algorithms are considered. The discussion includes a description of the tasks. All of the above tasks are useful; however, their value is determined in part by the time required to perform them. This work discusses three architectures for performing remote-sensing tasks. These architectures can execute the described tasks more quickly than conventionally available hardware.

47132 **(ANL/MCS-TM—73) Projected gradient methods for linearly constrained problems.** Calamai, P.H.; More, J.J. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.; Waterloo Univ., Ontario (Canada). Dept. of Systems Design Engineering). May 1986. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. File Number DE86014084.

The aim of this paper is to study the convergence properties of the projected gradient method and to apply these results to algorithms for linearly constrained problems. The main convergence result is obtained by defining a projected gradient, and proving that the gradient projection method forces the sequence of projected gradients to zero. A consequence of this result is that if the projected gradient method converges to a nondegenerate point of a linearly constrained problem, then the active and binding constraints are identified in a finite number of iterations. As an application to the theory, quadratic programming algorithms are developed that iteratively explore a subspace defined by the active constraints. These algorithms are able to drop and add many constraints from the active set, and can either compute an accurate minimizer by a direct method, or an approximate minimizer by an iterative method of the conjugate gradient type. Thus, these algorithms are attractive for large scale problems. It is shown that it is possible to develop a finitely terminating quadratic programming algorithm without nondegeneracy assumptions. 14 refs.

47133 **(DOE/MC/21377—2154) ASPEN costing manual.** Schwint, K.J. (Scientific Design Co., Inc., New York (USA)). 25 Jul 1986. Contract AC21-84MC21377. 452p. NTIS, PC A20/MF A01; 1; GPO Dep. File Number DE86014074.

The ASPEN program contains within it a Cost Estimation System (CES) which estimates the purchase cost and utility consumption rates for major pieces of equipment in a process flowsheet as well as installed equipment costs. These estimates are "preliminary-study grade" with an accuracy of plus or minus 30%. The ASPEN program also contains within it an Economic Evaluation System (EES) which estimates overall capital investment costs, annual operating expenses and profitability indices for a chemical plant. This ASPEN costing manual has been written as a guide for those inexperienced in the use of ASPEN and unfamiliar with standard cost estimating techniques who want to use the ASPEN CES and EES. The ASPEN Costing Manual is comprised of the following sections: (1) Introduction, (2) ASPEN Input Language, (3) ASPEN Cost Estimation System (CES), (4) ASPEN Cost Blocks; and (5) ASPEN Economic Evaluation System (EES).

47134 **(EGG—10282-1114) Information modeling techniques for scientific applications.** Baltz, D. (EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). 1986. Contract AC08-83NV10282. 27p. (CONF-860889—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE86014026.

From Structured development forum; Seattle, WA, USA (11 Aug 1986).

A series of transparencies graphically show processes involved in the acquisition, analysis, and processing of experimental data. Topics addressed include data base files, data structures, relationships between data and signal relationships.

47135 **(PNL-SA—14035) Data analysis management.** Cowley, P.J.; Nicholson, W.L.; Carr, D.B. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1986. Contract AC06-76RL01830. 16p. (CONF-860758—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE86013593.

From 13. international biometric conference; Seattle, WA, USA (28 Jul 1986).

Data analysis management is a methodology to assist the analyst in tracking the events of data analysis by allowing the analyst to designate milestones of the analysis, which we call "save-states". A prototype data analysis management system, which is described in this paper, includes capabilities to graphically depict the course of the analysis, the ability to return to previous save-states, the ability to use segments of the log that describe the course of the analysis, and the ability to associate both written and spoken documentation with the analysis. 6 refs., 3 figs.

47136 **(UCRL—92925-Rev.1) Guidelines for the syntactic design of audio cues in computer interfaces. Revision 1.** Sumikawa, D.A.; Blattner, M.M.; Joy, K.I.; Greenberg, R.M. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA)). May 1986. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86014429.

Earcons are audio cues used in the computer/user interface to provide information and feedback to the user about computer entities. (Earcons include messages and functions, as well as states and labels.) Design guidelines are presented for the syntax of earcons. Earcons are constructed from pitches, rhythms, and motives, short sequences of notes with a specific rhythm and pitch, embellished by timbre, dynamics, and register. Compound earcons and family earcons are introduced. These are related motives that serve to identify a family of related cues. Examples of earcons are given. 18 refs., 4 figs., 1 tab.

47137 **(UCRL—94377) Interactive wrapper tool for mapping objects to Fortran library functions.** Lawver, B.S. (Lawrence Livermore National Lab., CA (USA)). 1 Apr 1986. Contract W-7405-ENG-48. 11p. (CONF-860967—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86009686.

From ACM conference on object oriented programming systems, languages, and applications; Portland, OR, USA (29 Sep 1986).

A wrapper serves as a software interface between non-object-oriented software and software that must be used but exists in a form that is not object-oriented. a tool designed to accomplish the wrapping function for a library of Fortran routines used by the Electrical Engineering Department at Lawrence Livermore National Laboratory is described. 7 refs., 6 figs. (DWL)

47138 **Scientific uses of the MANIAC.** Anderson, H.L. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Statistical Physics;* **43**: No. 3, 731-748(Jun 1986).

This is the story of how Nick Metropolis came to build the MANIAC and about the scientific uses to which it was put in the early days of electronic computing. Among the illustrious scientists attracted to MANIAC were Fermi, Teller, von Neumann, Bethe, Gamow, and Ulam. Many of the scientific contributions were "firsts" that had a profound influence on subsequent developments over a wide spectrum of scientific activities. These included the pion—proton phase shift analysis, the nonlinear coupled oscillators, the study of the genetic code, importance sampling, two-dimensional hydrodynamics, Monte Carlo calculation of nuclear cascades, universalities of iterative functions and "anticlerical" chess.

47139 **Mathematics and computing.** Lax, P.D. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Statistical Physics;* **43**: No. 3, 749-756(Jun 1986).

Examples are given of the effects mathematics & computers have had on each other. The relability of computer calculations is discussed. (AIP)

47140 **Method for encryption and transmission of digital keying data.** Mniszewski, S.M.; Springer, E.A.; Brenner, D.P. (to Dept. of Energy). US Patent Application 6-730,529. 6 May 1985. 16p. Contract W-7405-ENG-36. DE86013712 NTIS, PC A02/MF A01; GPO Dep. File Number DE86013712.

A method for the encryption, transmission, and subsequent decryption of digital keying data is described. The method utilizes the Data Encryption Standard and is implemented by means of a pair of apparatus, each of which is selectable to operate as either a master unit or remote unit. The method enables frequent change of keys without requiring manual entry or storage of keys at the remote unit. 2 figs.

9905 Civilian Defense

47141 **(AD-A—167447/2/XAB) Effects of edge restraint on slab behavior. Final report.** Guice, L.K. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Feb 1986. 283p. NTIS, PC A13/MF A01.

This study was performed in conjunction with a Federal Emergency Management Agency program to plan, design, and construct keyworker blast shelters which would be used in high-risk areas of the country during and after a nuclear attack. The shelters considered in this study were box-type structures in which damage is much more likely to occur in the roof slab than in the walls or floor. In this part of the program, the effect of edge restraint on slab behavior was investigated. The primary objective was to determine the effects of partial rotational restraint on slab strength, ductility, and mechanism of failure. Sixteen one-way, reinforced concrete plate elements were tested in a reaction structure under uniform static water pressure.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC04-76EV01013	**Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM**	
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AC05-76OR00001	**Goodyear Atomic Corp., Piketon, OH (USA)**	
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AC05-76OR00033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
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AC05-84OR21400	**Oak Ridge National Lab., TN (USA)**	
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AC06-76RL01830	Pacific Northwest Lab., Richland, WA (USA)	
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AC07-76ID01570	EG and G, Inc., Middletown, PA (USA)	
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AC07-84ID12502	Enwright Research Corp., Greenville, SC (USA)	
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AC07-84ID12539	United Technologies Research Center, East Hartford, CT (USA)	
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AC08-76NV00410	Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)	
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AC08-80CS50101	Aerospace Corp., Washington, DC (USA). Electric and Hybrid Vehicle Directorate	
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AC08-83NV10282	EG and G Energy Measurements, Inc., Las Vegas, NV (USA)	
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AC09-76SR00001	Savannah River Lab., Aiken, SC (USA)	
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AC21-81MC16426	New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center	
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AC21-82MC19207	Massachusetts Inst. of Tech., Cambridge (USA)	
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AC21-83MC20183	State Univ. of New York, Buffalo (USA). Dept. of Chemical Engineering	
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AC21-84MC21171	Aerojet Energy Conversion Co., Sacramento, CA (USA)	
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AC21-84MC21289	Battelle Memorial Inst., Columbus, OH (USA)	
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AC21-84MC21377	Scientific Design Co., Inc., New York (USA)	
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AC22-85PC81201	Institute of Gas Technology, Chicago, IL (USA)	
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AH01-86FE60922	USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Oil, Gas and Shale Technology	
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AI05-82OR21005	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
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FC20-79LC10036	**Occidental Oil Shale, Inc., Grand Junction, CO (USA)**	
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FC21-83FE60177	**Western Research Inst., Laramie, WY (USA)**	
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FC21-83FE60181	**North Dakota Univ., Grand Forks (USA). Energy Research Center**	
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FC22-83FE60149	**National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)**	
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FG01-85CE15239	**Single-Ply Inst. of America, Inc., Pasadena, MD**	
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FG02-84CH10206	**Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.**	
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FG02-84CH10211	**Tuskegee Inst., AL (USA). Carver Research Foundation**	
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FG02-84ER45142	**Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy**	
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FG02-84ER45144	**Chicago Univ., IL (USA)**	
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FG02-84ER53188	**Missouri Univ., Rolla (USA). Dept. of Physics**	
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FG02-86ER60402	**Columbia Univ., New York (USA). Radiological Research Lab.**	
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FG03-84CE30805	**Burt-Hill-Kosar-Rittelmann Associates, Washington, DC (USA)**	
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FG03-86ER52130	**California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering**	
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FG04-84AL27458	**Lowell Univ., MA (USA). Radiation Lab.**	
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FG05-86ER60393	Louisiana State Univ., Baton Rouge (USA). Dept. of Zoology and Physiology	
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FG05-86ER60415	Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy	
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FG06-80R000484	Port Townsend, City of, OR (USA)	
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FG06-81R001242	Beck (William), Pullman, WA (USA)	
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FG09-85ER60376	North Carolina State Univ., Raleigh (USA). Dept. of Marine, Earth and Atmospheric Sciences	
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FG22-84PC70791	Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry	
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FG22-84PC70809	University of Southern California, Los Angeles (USA)	
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FG22-84PC71257	Pittsburgh Univ., PA (USA)	
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FG22-85PC80509	Delaware Univ., Newark (USA). Dept. of Chemical Engineering	
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FG22-85PC80533	Oklahoma Univ., Norman (USA). School of Chemical Engineering and Materials Science	
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	ASHRAE Trans., 91: No. 2A, 413-426(1985)			11:46056
	ASHRAE Trans., 91: No. 2A, 560-575(1985)			11:46057
	ASHRAE Trans., 91: No. 2B, 120-132(1985)			11:46058
	ASHRAE Trans., 91: No. 2B, 509-523(1985)			11:46059
	ASHRAE Trans., 91: No. 2B, 537-554(1985)			11:46060
	ASHRAE Trans., 91: No. 2B, 1185-1201(1985)			11:46061
	ASHRAE Trans., 91: No. 2B, 1761-1776(1985)			11:46062
	ASHRAE Trans., 91: No. 2B, 1777-1792(1985)			11:46063
	ASHRAE Trans., 91: No. 2A, 488-502(1985)			11:46064
	ASHRAE Trans., 91: No. 2B, 1421-1433(1985)			11:46065
	ASHRAE Trans., 91: No. 2A, 62-74(1985)			11:46066
	ASHRAE Trans., 91: No. 2A, 337-353(1985)			11:46067
	ASHRAE Trans., 91: No. 2B, 818-834(1985)			11:46069
	ASHRAE Trans., 91: No. 2B, 961-974(1985)			11:46070
	ASHRAE Trans., 91: No. 2B, 1510-1515(1985)			11:46071
CONF-8506271-	(2. Hungaro-Italian symposium on spectrochemistry: natural materials and spectral analysis, Budapest, Hungary, 10-14 Jun 1985)			
1	*See* ENEA-RT-TIB-86/3	DE86901526	MN -4	11:46224
CONF-8506290-	(International symposium on drug therapy and alternative therapy methods, Sopron, Hungary, 21-22 Jun 1985)			
Abstr.	*See* OEFZS-A-0686		ND -48	11:46694
CONF-8506305-	(International conference on surface and colloid chemistry, Potsdam, NY, USA, 24-28 Jun 1985)			
1	*See* N-86-25284			11:46190

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
CONF-8508188-	(Larval fish and shellfish transport through coastal inlets, Ocean Springs, MS, USA, 19-20 Aug 1985)			
1	*See* DOE/ER/60376-12b	E 1.99: DE86013057	MN -11	11:46753
CONF-8508192-	(1. international conference on deep freezing of boar semen, Uppsala, Sweden, 25-27 Aug 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014216	MN -48	11:46731
CONF-850932-	(Seminar on applied research and service activities for research reactor operations, Copenhagen, Denmark, 9-13 Sep 1985)			
3	*See* RT/TIB-85/27	DE86901559	MN -2	11:46244
CONF-8509126-	(Hot humid climate conference, College Station, TX, USA, 24-26 Sep 1985)			
6	*See* PNL-SA-13260	E 1.99: DE86011627	MN -95d	11:46033
CONF-8509315-	(Seminar on an integrated weather radar network for Western Europe, Erice, Italy, 30 Sep-3 Oct 1985)			
	See EUR-10353-EN-FR		ND -11	11:46639
CONF-8509317-	(SMM topical workshop on rapid fluctuations in solar flares, Lanham, MD, USA, 30 Sep-4 Oct 1985)			
1	*See* N-86-25316			11:46778
CONF-8510101-	(Boulder damage symposium, Boulder, CO, USA, 15-17 Oct 1985)			
8	*See* LA-UR-86-2542	E 1.99: DE86013830	MN -38	11:46362
CONF-8510153-	(11. MPA seminar, Stuttgart, F.R. Germany, 10-11 Oct 1985)			
5-Trans.	*See* BLL-RISLEY-TR-280-(9091.9F)			11:45870
CONF-8510160-	(ASM metals congress/TMS-AIME fall meeting, Toronto, Ontario, Canada, 13-18 Oct 1985)			
19	*See* EGG-J-01586	E 1.99: DE86013457	MN -38	11:46380
CONF-8510205-	(3. international conference on low-level counting, Bratislava, Czechoslovakia, 21-25 Oct 1985)			
Abstr.	*See* INIS-mf-10174	DE86703198	MN -37	11:46579
CONF-8510266-	(International pellet fueling workshop, La Jolla, CA, USA, 30 Oct-3 Nov 1985)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014230	MN -20	11:47091
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014229	MN -20	11:47092
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014222	MN -20d	11:47093
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014231	MN -20	11:47094
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014027	MN -20d	11:47034
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014236	MN -20	11:47035
CONF-8511123-	(2. international technical symposium on optical and electro-optical applied science and engineering, Cannes, France, 25 Nov-6 Dec 1985)			
5	*See* LBL-20466	E 1.99: DE86013485	MN -37	11:46619
CONF-8511131-	(5. international workshop on electron cyclotron emission and electron cyclotron heating, San Diego, CA, USA, 9-12 Nov 1985)			
6	*See* GA-A-18027	E 1.99: DE86014034	MN -20	11:47043
CONF-8511220-	(Seminar on nuclear data, Tokai, Japan, 12-14 Nov 1985)			
	See NEANDC(J)-120/U	TI86901587	ND -34C	11:46897
CONF-851202-	(DOE-ORNL-ASHRAE-BTECC conference on thermal performance of the exterior envelopes of buildings-III, Clearwater Beach, FL, USA, 2-5 Dec 1985)			
15	*See* SERI/TP-254-2999	E 1.99: DE86010725	MN -62	11:46035
CONF-851215-	(International load management conference and exposition, Chicago, IL, USA, 9-11 Dec 1985)			
	See EPRI-EM-4643	TI86920370	ND -97b	11:45836
CONF-851281-	(DNA metabolism influencing factors, Vienna, Austria, 5-6 Dec 1985)			
Abstr.	*See* OEFZS-A-0756		ND -23	11:46729
CONF-851286-	(Symposium on magnetic resonanace of excited state molecules, Kyoto, Japan, 21-22 Dec 1985)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013389	MN -4	11:46291
CONF-860148-	(2. United States/Mexico cooperative symposium on atomic and molecular physics, Cocoyoc, Mexico, 1 Jan 1986)			
6	*See* KU-HCOE-FL2-R-85-27	DE86752094	MN -34A	11:46802
CONF-860150-	(Winter condensed matter physics conference: frontiers in condensed matter X-ray physics, Aspen, CO, USA, 12-18 Jan 1986)			
6	*See* ANL-HEP-CP-86-32	E 1.99: DE86014604	MN -28	11:46484
CONF-860152-	(10. annual conference on composites and advanced ceramic materials, Cocoa Beach, FL, USA, 19-24 Jan 1986)			
4	*See* N-86-24836			11:46171
5	*See* N-86-24839			11:46172
6	*See* N-86-25476			11:46113
CONF-860179-	(Workshop on astronomical observations from a lunar base, Houston, TX, USA, 10 Jan 1986)			
1	*See* LA-UR-86-1481	E 1.99: DE86010207	MN -13	11:47128
CONF-860204-	(Thermal reactor safety meeting, San Diego, CA, USA, 2-6 Feb 1986)			
39	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86008993	MN -80	11:45903

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CONF-860272-	(Wire chamber conference, Vienna, Austria, 25-28 Feb 1986)				
Abstr.	*See* INIS-mf-10173		DE86703196	MN -37	11:46489
CONF-860297-	(5. international cadmium conference, San Francisco, CA, USA, 1 Feb 1986)				
1	*See* BNL-38374	E 1.99:	DE86014174	MN -48	11:46735
CONF-860315-	(International symposium on the optimization of radiation protection, Vienna, Austria, 10-14 Mar 1986)				
1	*See* PNL-SA-13454	E 1.99:	DE86013340	MN -41	11:46730
CONF-860340-	(115. American Institute of Mining, Metallurgical and Petroleum Engineers annual meeting, New Orleans, LA, USA, 2-6 Mar 1986)				
7	*See* N-86-25453				11:46149
CONF-860366-	(SPIE technical symposium on applications of artificial intelligence, Orlando, FL, USA, 31 Mar 1986)				
10	*See* BNL-38387	E 1.99:	DE86014176	MN -28	11:46445
CONF-8603139-	(Southeastcon '86: IEEE region 3 conference and exhibit, Richmond, VA, USA, 23-26 Mar 1986)				
1	*See* Y/DW-642		DE86012720	MN -38	11:46392
CONF-860405-	(10. annual symposium on energy from biomass and wastes, Washington, DC, USA, 7-10 Apr 1986)				
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014580	MN -61E	11:45754
CONF-860425-	(191. American Chemical Society national meeting, New York, NY, USA, 13-18 Apr 1986)				
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 2, 613(Apr 1986)				11:45674
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 2, 613(Apr 1986)				11:45675
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 1, 169(Mar 1986)				11:45750
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 1, 182(Mar 1986)				11:45751
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 1, 198-207(Mar 1986)				11:45752
	Am. Chem. Soc., Div. Pet. Chem., Prepr., 31: No. 1, 317(Mar 1986)				11:45753
CONF-860441-	(5. international conference on ultra-relativistic nucleus-nucleus collisions (Quark Matter '86), Pacific Grove, CA, USA, 13-17 Apr 1986)				
4	*See* BNL-38229	E 1.99:	DE86014137	MN -34D	11:46485
6	*See* BNL-38298	E 1.99:	DE86014185	MN -34D	11:46892
CONF-860447-	(American Institute of Chemical Engineers spring national meeting, New Orleans, LA, USA, 6-10 Apr 1986)				
	New York, NY; American Institute of Chemical Engineers (1986).				11:45616
	New York, NY; American Institute of Chemical Engineers (1986).				11:45624
	New York, NY; American Institute of Chemical Engineers (1986).				11:45625
	New York, NY; American Institute of Chemical Engineers (1986).				11:45638
	New York, NY; American Institute of Chemical Engineers (1986).				11:45684
	New York, NY; American Institute of Chemical Engineers (1986).				11:45757
CONF-8604103-	(Conference on frontiers of electron microscopy in materials science, Argonne, IL, USA, 21-23 Apr 1986)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014579	MN -38	11:46486
CONF-8604165-	(International conference on heavy ion physics, Rochester, NY, USA, 21-22 Apr 1986)				
8	*See* LBL-21580	E 1.99:	DE86013199	MN -34C	11:46976
9	*See* LBL-21462	E 1.99:	DE86013203	MN -34C	11:46991
CONF-8604194-	(International symposium on three-body force in the three-nucleon system, Washington, DC, USA, 24-26 Apr 1986)				
2	*See* LA-UR-86-2139	E 1.99:	DE86012399	MN -34C	11:46904
5	*See* SLAC-PUB-3973	E 1.99:	DE86012961	MN -34D	11:46992
CONF-8604222-	(70. annual meeting of the Federation of American Society for Experimental Biology, St. Louis, MO, USA, 13-18 Apr 1986)				
	Fed. Proc. Fed. Amer. Soc. Exp. Biol., 45: No. 3, 392(1 Mar 1986)				11:45649
	Fed. Proc. Fed. Amer. Soc. Exp. Biol., 45: No. 3, 392(1 Mar 1986)				11:46697
	Fed. Proc. Fed. Amer. Soc. Exp. Biol., 45: No. 3, 312(1 Mar 1986)				11:46704
CONF-8604229-	(2. international symposium on biological reference materials, Neuherberg, F.R. Germany, 24-25 Apr 1986)				
1	*See* BNL-38365	E 1.99:	DE86014173	MN -48	11:46223

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CONF-860501-	(Conference on the science and technology of fast reactor safety, Channel Islands, UK, 12-16 May 1986)			
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014493	MN -79p	11:45861
15	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014494	MN -79p	11:45904
CONF-860510-	(Symposium on heavy ion fusion, Washington, DC, USA, 27-29 May 1986)			
11	*See* LA-UR-86-2636	E 1.99: DE86013821	MN -21	11:47101
12	*See* UCRL-94348	E 1.99: DE86014428	MN -21	11:46442
CONF-860522-	(7. international conference on plasma surface interactions in controlled fusion devices, Princeton, NJ, USA, 5-9 May 1986)			
19	*See* GA-A-18455	E 1.99: DE86014030	MN -21	11:47098
20	*See* GA-A-18454	E 1.99: DE86014028	MN -21	11:47044
CONF-860535-	(3. annual heat engines contractors' meeting, Morgantown, WV, USA, 6-8 May 1986)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014595	MN -90h	11:45639
CONF-860551-	(Technical meeting and workshop on fusion reactor design and technology, Yalta, USSR, 26 May-6 Jun 1986)			
8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014593	MN -20	11:47088
CONF-860575-	(2. conference on particle and nuclear physics, Lake Louise, Canada, 26-31 May 1986)			
14	*See* UCRL-94764	E 1.99: DE86012806	MN -34C	11:46905
16	*See* LBL-21673	E 1.99: DE86013009	MN -28	11:46426
17	*See* LBL-21536	E 1.99: DE86013190	MN -28	11:46425
18	*See* DOE/ER/02853-29	E 1.99: DE86013356	MN -34C	11:46985
20	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013343	MN -28	11:46469
21	*See* DOE/ER/40048-163-L6	E 1.99: DE86013146	MN -34D	11:46838
22	*See* LBL-21716	E 1.99: DE86013472	MN -34D	11:46842
23	*See* BNL-38285	E 1.99: DE86013913	MN -34D	11:46835
26	*See* LA-UR-86-2540	E 1.99: DE86013831	MN -34C	11:46859
29	*See* BNL-38304	E 1.99: DE86014131	MN -34D	11:46836
30	*See* BNL-38336	E 1.99: DE86014182	MN -34D	11:46902
31	*See* DOE/ER/40048-26-N6	E 1.99: DE86014282	MN -34D	11:46893
32	*See* DOE/ER/40048-29-N6	E 1.99: DE86014284	MN -34D	11:46864
35	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014584	MN -28	11:46433
CONF-8605139-	(Minimars review meeting, Toronto, Canada, 20 May 1986)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86011758	MN -20	11:47095
CONF-8605146-	(15. Yamada conference on physics and chemistry of quasi one-dimensional conductors, Lake Kawaguchi, Japan, 26-30 May 1986)			
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014588	MN -34	11:46196
CONF-8605150-	(Beijing symposium on physics at tandem, Beijing, China, 26-30 May 1986)			
2	*See* DOE/ER/40048-162	DE86013147	MN -34C	11:46974
CONF-8605158-	(Department of Energy nuclear data committee meeting, Germantown, MD, USA, 1-2 May 1986)			
1	*See* BNL-NCS-37975	E 1.99: DE86012708	MN -34C	11:46970
CONF-8605162-	(International symposium on production and decay of heavy flavours, Heidelberg, F.R. Germany, 19-23 May 1986)			
1	*See* SLAC-PUB-4001	E 1.99: DE86012959	MN -34D	11:46851
CONF-8605163-	(Workshop on physics simulation at high energies, Madison, WI, USA, 5-16 May 1986)			
4	*See* LBL-21695	E 1.99: DE86013487	MN -34D	11:46849
CONF-8605164-	(2. topical seminar on perspectives for experimental apparatus at future high energy machines, San Miniato, Italy, 5-9 May 1986)			
1	*See* SLAC-PUB-4020	E 1.99: DE86013434	MN -28	11:46606
CONF-8605167-	(Workshop on forest crop nutrition: production, prices and pathways, Kingston, Ontario, Canada, 20-23 May 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013410	MN -11	11:46652
CONF-860601-	(4. international conference on emerging nuclear energy systems, Madrid, Spain, 30 Jun-4 Jul 1986)			
7	*See* BNL-38384	E 1.99: DE86014168	MN -21	11:47084
8	*See* BNL-38379	E 1.99: DE86014169	MN -80	11:45857
CONF-860602-	(17. rare earth research conference, Hamilton, Ontario, Canada, 8-12 Jun 1986)			
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014568	MN -34	11:46193
CONF-860604-	(International symposium on the packaging and transport of radioactive materials (PATRAM '86), Davos, Switzerland, 16-20 Jun 1986)			
28	*See* EGG-M-T-0286	E 1.99: DE86013459	MN -71	11:45711
CONF-860605-	(13. international symposium on the effects of radiation on materials, Seattle, WA, USA, 23-25 Jun 1986)			
18	*See* EGG-M-22985	E 1.99: DE86013469	MN -2	11:45894
19	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014492	MN -25	11:46125
21	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014531	MN -25	11:46126
22	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014529	MN -25	11:46127
23	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014530	MN -25	11:46128
24	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014499	MN -25	11:46129

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CONF-860608-	(World congress on high tech ceramics: electronic, engineering, nuclear, biomedical research and applications in focus, Milan, Italy, 23-27 Jun 1986)				
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014490	MN -25	11:46194
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014491	MN -25	11:46195
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014558	MN -90c	11:45589
CONF-860610-	(American Nuclear Society annual meeting, Reno, NV, USA, 15-20 Jun 1986)				
2	NTIS, PC A02/MF A01 - GPO		TI86005151	MN -80	11:45905
16	*See* BNL-NUREG-37691		TI86007123	MN -80	11:45901
CONF-860629-	(Linear accelerator conference, Stanford, CA, USA, 2-6 Jun 1986)				
21	*See* SLAC-PUB-3980	E 1.99:	DE86012876	MN -28	11:46605
25	*See* SLAC-PUB-3981	E 1.99:	DE86013441	MN -28	11:46429
28	*See* SLAC-PUB-3977	E 1.99:	DE86013508	MN -28	11:46439
30	*See* SLAC-PUB-3965	E 1.99:	DE86013438	MN -28	11:46438
31	*See* SLAC-PUB-3936	E 1.99:	DE86013435	MN -28	11:46428
34	*See* SLAC-PUB-3945	E 1.99:	DE86013507	MN -28	11:46463
35	*See* SLAC-PUB-3979	E 1.99:	DE86014087	MN -28	11:46440
CONF-860652-	(7. topical meeting on the technology of fusion energy, Reno, NV, USA, 15-19 Jun 1986)				
11	*See* EGG-M-01286	E 1.99:	DE86013489	MN -20	11:47097
15	*See* UCRL-94115	E 1.99:	DE86013899	MN -20d	11:47122
16	*See* UCRL-94084	E 1.99:	DE86013898	MN -20d	11:47121
18	*See* UCRL-94693	E 1.99:	DE86013901	MN -20d	11:47123
19	*See* LA-UR-86-2299	E 1.99:	DE86013858	MN -20f	11:47100
20	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014620	MN -20	11:47089
21	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014527	MN -20d	11:47090
CONF-860654-	(27. annual meeting of the Institute of Nuclear Materials Management, New Orleans, LA, USA, 22-25 Jun 1986)				
39	*See* GAT-NM-137	E 1.99:	DE86013557	MN -16	11:45736
40	*See* BNL-38314	E 1.99:	DE86014130	MN -15	11:45735
CONF-860655-	(American Solar Energy Society annual meeting and 11. national passive solar conference, Boulder, CO, USA, 8-14 Jun 1986)				
14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014484	MN -59A	11:45796
15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014488	MN -62	11:45797
CONF-860663-	(24. symposium of engineering aspects of magnetohydrodynamics, Butte, MT, USA, 24-27 Jun 1986)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014532	MN -90g	11:46019
CONF-860665-	(6. international conference on high power particle beams, Kobe, Japan, 9-12 Jun 1986)				
14	*See* UCRL-93757	E 1.99:	DE86013222	MN -28	11:46441
CONF-8606112-	(IASTED modelling and simulation conference, Vancouver, Canada, 4-6 Jun 1986)				
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014495	MN -96	11:46076
CONF-8606127-	(7. international conference on modern trends in activation analysis, Copenhagen, Denmark, 23-27 Jun 1986)				
2	*See* PNL-SA-13923	E 1.99:	DE86013599	MN -48	11:46739
CONF-8606128-	(Production and transport of secondary beam at a kaon factory workshop, Vancouver, B.C., Canada, 1-4 Jun 1986)				
3	*See* BNL-38310	E 1.99:	DE86014132	MN -28	11:46444
CONF-8606139-	(Health Physics Society meeting, Pittsburgh, PA, USA, 30 Jun 1986)				
4	*See* SLAC-PUB-3968	E 1.99:	DE86012045	MN -28	11:46604
CONF-8606147-	(9. North American forest biology workshop, Stillwater, OK, USA, 15-18 Jun 1986)				
2	*See* UCRL-94281	E 1.99:	DE86014435	MN -61A	11:46740
CONF-8606152-	(17. international Rochester conference, Rochester, NY, USA, 2-6 Jun 1986)				
3	*See* BNL-38373	E 1.99:	DE86014129	MN -48	11:46734
CONF-8606153-	(DARPA conference, Albuquerque, NM, USA, 23-26 Jun 1986)				
2	*See* SAND-86-1544C	E 1.99:	DE86012945	MN -28	11:46620
3	*See* SAND-86-1539C	E 1.99:	DE86012944	MN -28	11:46436
5	*See* UCRL-94759	E 1.99:	DE86013019	MN -28	11:46443
6	*See* SAND-86-1654C	E 1.99:	DE86014150	MN -28	11:46437
CONF-8606157-	(NATO advanced study conference, Les Houche, France, 16-26 Jun 1986)				
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014232	MN -34A	11:46795
CONF-8606161-	(Conference on health and environmental effects of complex chemical mixtures, Delavan, WI, USA, 16-18 Jun 1986)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014205	MN -48	11:46736
CONF-8606165-	(Data systems users working group meeting of the Space Physics Analysis Network (SPAN), Greenbelt, MD, USA, 8-9 May 1986)				
1	*See* LA-UR-86-2181	E 1.99:	DE86012441	MN -4	11:46307
CONF-8606166-	(Meeting of the Fellows of the Royal Society, London, UK, 27 Jun 1986)				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011974	MN -34A	11:46796

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CONF-8606173-	(1. symposium on computational chemistry on cray supercomputers, Minneapolis, MN, USA, 11-13 Jun 1986)			
1	*See* SAND-86-1751C	E 1.99: DE86013573	MN -34A	11:46806
CONF-8606175-	(Workshop on the use of supercomputers in stellar dynamics, Princeton, NJ, USA, 2-4 Jun 1986)			
1	*See* LA-UR-86-2350	E 1.99: DE86013854	MN -34B	11:46776
CONF-8606181-	(4. international conference on particle induced X-ray emission and its analytical applications, Tallahassee, FL, USA, 9-13 Jun 1986)			
2	*See* BNL-38357	E 1.99: DE86014127	MN -48	11:46733
4	*See* BNL-38355	E 1.99: DE86014172	MN -48	11:46732
CONF-8606182-	(5. international school of cosmic ray astrophysics, Erice, Italy, 1-9 Jun 1986)			
1	*See* LA-UR-86-2590	E 1.99: DE86013825	MN -34B	11:46602
CONF-8606184-	(22. joint propulsion conference, Huntsville, AL, USA, 16-19 Jun 1986)			
1	*See* N-86-24961			11:46328
CONF-860701-	(23. international conference on high-energy physics, Berkeley, CA, USA, 16-23 Jul 1986)			
7	*See* BNL-38385	E 1.99: DE86014167	MN -34D	11:46837
8	*See* FNAL/C-86/102-E	E 1.99: DE86014372	MN -34D	11:46839
CONF-860702-	(5. international conference on surface modification of metals by ion beams, Kingston, Ontario, Canada, 7-11 Jul 1986)			
2	*See* SAND-86-0809C	E 1.99: DE86014146	MN -25	11:46152
CONF-860703-	(4. international conference on megagauss magnetic-field generation and related topics, Santa Fe, NM, USA, 14-17 Jul 1986)			
9	*See* UCRL-94446	E 1.99: DE86013021	MN -38	11:46352
12	*See* LA-UR-86-2507	E 1.99: DE86013833	MN -38	11:46341
13	*See* LA-UR-86-2352	E 1.99: DE86013853	MN -38	11:46338
14	*See* LA-UR-86-2381	E 1.99: DE86013846	MN -21	11:47048
15	*See* LA-UR-86-2388	E 1.99: DE86013842	MN -28	11:46455
16	*See* LA-UR-86-2371	E 1.99: DE86013851	MN -38	11:46339
18	*See* LA-UR-86-2378	E 1.99: DE86013848	MN -38	11:46340
19	*See* LA-UR-86-2379	E 1.99: DE86013847	MN -38	11:46399
20	*See* LA-UR-86-2412	E 1.99: DE86013839	MN -38	11:46401
21	*See* LA-UR-86-2419	E 1.99: DE86013837	MN -20f	11:47049
22	*See* LA-UR-86-2413	E 1.99: DE86013838	MN -38	11:46601
23	*See* LA-UR-86-2372	E 1.99: DE86013850	MN -38	11:46398
24	*See* LA-UR-86-2387	E 1.99: DE86013843	MN -38	11:46400
25	*See* UCRL-94857	E 1.99: DE86014439	MN -35	11:46635
26	*See* UCRL-94277	E 1.99: DE86014440	MN -32	11:46823
27	*See* UCRL-94856	E 1.99: DE86014448	MN -38	11:46407
29	*See* UCRL-94855	E 1.99: DE86014447	MN -38	11:46406
CONF-860709-	(Conference on research and applications of aquatic plants for water treatment and resource recovery, Orlando, FL, USA, 20-24 Jul 1986)			
1	*See* PNL-SA-13853	E 1.99: DE86014376	MN -61	11:45749
CONF-860710-	(13. annual plasma physics conference, Oxford, UK, 2-4 Jul 1986)			
1	*See* SAND-86-1706C	E 1.99: DE86014370	MN -21	11:47112
CONF-860741-	(International symposium on weak and electromagnetic interactions in nuclei, Heidelberg, F.R. Germany, 1-5 Jul 1986)			
8	*See* DOE/ER/02853-30	E 1.99: DE86013355	MN -34C	11:46986
9	*See* PNL-SA-14160	E 1.99: DE86013592	MN -34D	11:46947
11	*See* LA-UR-86-2386	E 1.99: DE86013844	MN -34D	11:46868
CONF-860746-	(Anomalous rare earths and actinides, Grenoble, France, 7-11 Jul 1986)			
3	*See* BNL-38329	E 1.99: DE86014125	MN -25	11:46124
CONF-860752-	(33. international field emission symposium (IFES), Berlin, F.R. Germany, 6-12 Jul 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86012631	MN -25	11:46130
CONF-860753-	(International conference on EXAFS and near edge structure, Saumur, France, 7-11 Jul 1986)			
2	*See* BNL-38486	E 1.99: DE86014178	MN -34A	11:46794
CONF-860755-	(4. Rochester conference, Rochester, NY, USA, 11-14 Jul 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013403	MN -32	11:46395
CONF-860756-	(NATO advanced study institutes program conference, Pitlochry, Scotland, 13-25 Jul 1986)			
1	*See* SAND-86-1722C	E 1.99: DE86013563	MN -28	11:46427
CONF-860757-	(Western Division of the American Fisheries Society annual meeting, Portland, OR, USA, 21-23 Jul 1986)			
1	*See* PNL-SA-13422	E 1.99: DE86013595	MN -11	11:45761
CONF-860758-	(13. international biometric conference, Seattle, WA, USA, 28-31 Jul 1986)			
1	*See* PNL-SA-14035	E 1.99: DE86013593	MN -32	11:47135
CONF-860760-	(17. annual meeting of the Fine Particle Society, San Francisco, CA, USA, 28 Jul-2 Aug 1986)			
1	*See* SAND-85-2707C	E 1.99: DE86014142	MN -34	11:46822

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CONF-860810-	(Intersociety energy conversion engineering conference, San Diego, CA, USA, 25-29 Aug 1986)			
19	*See* BNL-38312	E 1.99: DE86014124	MN -80	11:45872
20	*See* DOE/NASA-1005-9	E 1.99: DE86010333	STD -38	11:46417
CONF-860820-	(19. DOE/NRC nuclear air cleaning conference, Seattle, WA, USA, 17-21 Aug 1986)			
2	*See* LA-UR-86-2396	E 1.99: DE86013841	MN -41	11:46393
CONF-860822-	(12. annual symposium on underground coal gasification, Saarbrucken, F.R. Germany, 25-28 Aug 1986)			
	See DOE/FE/60922-H1	E 1.99: DE86011811	STD -90c	11:45595
CONF-860829-	(Annual joint meeting of the Electron Microscopy of America and the Microbeam Analysis Society, Albuquerque, NM, USA, 10-15 Aug 1986)			
33	*See* KAPL-4193	E 1.99: DE86009673	STD -32	11:46600
CONF-860856-	(Conference on review of progress in quantitative NDE, San Diego, CA, USA, 3-8 Aug 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014224	MN -38	11:46387
CONF-860880-	(30. SPIE technical symposium on optics and optoelectronic engineering, San Diego, CA, USA, 17-22 Aug 1986)			
17	*See* LA-UR-86-2369	E 1.99: DE86013852	MN -34	11:46803
18	*See* BNL-38364	E 1.99: DE86014171	MN -37	11:46617
19	*See* SERI/TP-255-2995	E 1.99: DE86010727	MN -62	11:45800
CONF-860884-	(International carnahan conference on security technology, Gothenburg, Sweden, 12-14 Aug 1986)			
2	*See* SAND-86-1695C	E 1.99: DE86014147	MN -15	11:45737
CONF-860888-	(International symposium on remote sensing for resources development and environmental management, Enschede, Netherlands, 25-29 Aug 1986)			
1	*See* LA-UR-86-1596	E 1.99: DE86011258	MN -11	11:46705
CONF-860889-	(Structured development forum, Seattle, WA, USA, 11-14 Aug 1986)			
1	*See* EGG-10282-1114	E 1.99: DE86014026	MN -32	11:47134
CONF-860892-	(18. international conference on physics of semiconductors, Stockholm, Sweden, 11-15 Aug 1986)			
1	*See* LA-UR-86-2528	E 1.99: DE86013832	MN -34A	11:47012
CONF-860893-	(International symposium on fundamental research strategy in the development of new materials for efficient energy conversion, Osaka, Japan, 25-27 Aug 1986)			
1	*See* UCRL-94731	E 1.99: DE86014434	MN -93	11:46331
CONF-860894-	(4. international RILEM symposium on creep and shrinkage of concrete: mathematical modeling, Evanston, IL, USA, 26-29 Aug 1986)			
1	*See* UCRL-94282	E 1.99: DE86014437	MN -25	11:46391
CONF-860901-	(10. CIB congress on advancing building technology, Washington, DC, USA, 21-26 Sep 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86008981	MN -95d	11:46022
CONF-860903-	(IEEE-Industry Applications Society annual meeting, Denver, CO, USA, 28 Sep-2 Oct 1986)			
1	*See* SAND-86-1600C	E 1.99: DE86013350	MN -38	11:46404
CONF-860904-	(International gas research conference, Toronto, Canada, 8-11 Sep 1986)			
1	*See* UCRL-93040	E 1.99: DE86009895	MN -4	11:46414
CONF-860913-	(International power sources symposium, Brighton, UK, 8-11 Sep 1986)			
2	*See* N-86-25039			11:45966
CONF-860926-	(Geothermal Resources Council annual meeting, Palm Springs, CA, USA, 29 Sep-1 Oct 1986)			
1	*See* SAND-86-1084C	E 1.99: DE86009854	MN -38	11:46415
2	*See* LA-UR-86-1404	E 1.99: DE86010198	MN -66	11:45804
3	*See* SAND-86-2023C	E 1.99: DE86010997	MN -66	11:45811
4	*See* SAND-86-1120C	E 1.99: DE86010999	MN -66c	11:45809
5	*See* SAND-86-1128C	E 1.99: DE86011184	MN -66a	11:45810
6	*See* EGG-M-10286	E 1.99: DE86011048	MN -66a	11:45808
7	*See* SAND-86-1127C	E 1.99: DE86011421	MN -66b	11:45807
8	*See* SAND-86-1126C	E 1.99: DE86011656	MN -66	11:45806
9	*See* LA-UR-86-2009	E 1.99: DE86012374	MN -66a	11:45803
10	*See* LBL-21727	E 1.99: DE86013473	MN -66a	11:45805
11	*See* BNL-38019	E 1.99: DE86013919	MN -66d	11:45812
CONF-860932-	(Radiological accidents, perspectives and emergency planning preparedness, Bethesda, MD, USA, 15-17 Sep 1986)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86008499	MN -41	11:45906
CONF-860940-	(Gas cleaning at high temperatures conference, Guildford, Surrey, UK, 16-18 Sep 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86005551	MN -90e	11:45640
CONF-860950-	(17. international congress on high speed photography and photonics, Pretoria, South Africa, 1-5 Sep 1986)			
1	*See* UCRL-93185	E 1.99: DE86008164	MN -38	11:46390
CONF-860962-	(International Institute of Refrigeration (CRYOPRAGUE), Prague, Czechoslovakia, 8-12 Sep 1986)			
1	*See* LA-UR-86-1076	E 1.99: DE86008757	MN -38	11:46337

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CONF-860966-1	(Space electronics conference, Albuquerque, NM, USA, 9-11 Sep 1986) *See* SAND-86-0845C	E 1.99: DE86009025	MN -38	11:46403
CONF-860967-1	(ACM conference on object oriented programming systems, languages, and applications, Portland, OR, USA, 29 Sep-2 Oct 1986) *See* UCRL-94377	E 1.99: DE86009686	MN -32	11:47137
CONF-860968-1	(3. international conference on the science of technology of zirconia, Tokyo, Japan, 9-11 Sep 1986) *See* SAND-86-7115C	E 1.99: DE86013575	MN -94c	11:45968
CONF-860983-1	(Oceans '86, Washington, DC, USA, 23-25 Sep 1986) *See* SERI/TP-253-2965	E 1.99: DE86010710	MN -64	11:45784
CONF-860984-1	(British national committee for electroheat, heating, and processing conference, Cambridge, UK, 23-26 Sep 1986) *See* IS-M-574	E 1.99: DE86011398	MN -90d	11:45634
CONF-860985-1	(International symposium on rock stress and rock stress measurements, Stockholm, Sweden, 1-3 Sep 1986) *See* UCRL-93645	E 1.99: DE86010975	MN -85	11:45714
CONF-8609101-1	(International conference on power beam technology, Brighton, UK, 10-12 Sep 1986) NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011076	MN -25	11:46131
CONF-8609108-1	(International symposium on the scientific bases for the preparation of heterogeneous catalysts, Louvain-La-Neuve, Belgium, 1-5 Sep 1986) *See* SAND-86-0824C	E 1.99: DE86012278	MN -25	11:46199
CONF-8609110-1	(International conference on solid state nuclear track detectors, Rome, Italy, 23-27 Sep 1986) *See* PNL-SA-13220	E 1.99: DE86011121	MN -37	11:46603
CONF-8609116-1	(3. international conference on numerical methods for non-linear problems, Dubrovnik, Yugoslavia, 15-18 Sep 1986) *See* UCRL-94800	E 1.99: DE86013221	MN -34	11:46824
CONF-8609117-1	(19. congress of the International Association of Hydrogeologists, Karlovy Vary, Czechoslovakia, 8-15 Sep 1986) NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013396	MN -70B	11:45722
CONF-8609118-1	(C.I.G.R.E. meeting, Paris, France, 4 Sep 1986) NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013253	MN -97	11:45839
CONF-8609119-1	(Building design and construction conference, Beijing, China, 1-3 Sep 1986) *See* UCRL-94815	E 1.99: DE86013023	MN -20b	11:47124
CONF-8609120-1	(NATO workshop on the design, activation and transformation of organometallics into common and exotic materials, Cape d'Agde, France, 1-5 Sep 1986) NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013402	MN -25	11:46169
CONF-8609122-2	*See* SAND-86-1701C	E 1.99: DE86014149	MN -25	11:46201
CONF-861015-1	(15. North American Thermal Analysis Society conference, Cincinnati, OH, USA, 21-24 Sep 1986) *See* SAND-86-1601C	E 1.99: DE86013353	MN -25	11:46200
COO-3139-51	(Joint conference of the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, Pittsburgh, PA, USA, 19-22 Oct 1986) *See* N-86-25473			11:46198
CPT-85-002	*See* DOE/EV/03139-51	E 1.99: DE86014663	MN -48	11:46737
DGRST-81-D-0512	*See* DOE/ER/03992-578	E 1.99: DE86014621	MN -34D	11:46863
81-D-0513	NTIS (US Sales Only), PC A05/MF A01; 1 *See* DGRST-81-D-0512	DE86752844	MN -92	11:45682
DOE/AL/27658-T1		DE86752844	MN -92	11:45682
DOE/BC/10744-8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86013887	MN -23	11:45739
DOE/BP-555	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99: DE86000285	STD -92a	11:45653
696	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86012884	MN -13	11:45840
DOE/BP/11191-8	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014537	MN -97c	11:46014
9	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86012911	MN -60	11:45818
10	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86012860	MN -60	11:45817
DOE/BP/11548-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86012863	MN -60	11:45819
DOE/BP/34796-1	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE86013878	MN -11	11:45760
DOE/CE/15239-T3	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE86014192	MN -11	11:46684
DOE/CE/30805-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013244	MN -63	11:45763
DOE/CE/40568-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014155	MN -95d	11:46029
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DOE/CE/50070-T16	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014165	MN -96	11:46117
DOE/CE/65601-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86013331	MN -95	11:46011
DOE/CH/10206-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86011920	MN -60	11:45815
DOE/CH/10211-5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014153	MN -23	11:45740
DOE/CS/30353-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014711	MN -59B	11:45788
DOE/CS/50101-T15	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86014038	MN -96	11:46115
DOE/DP/00539-056	NTIS, PC A08/MF A01 (GPO Dep.)	E 1.99: DE86014406	STD -41	11:46649
057	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014090	STD -41	11:46650
DOE/DP/50039-T1	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86013943	MN -13	11:46638
DOE/EIA-0095(85)	NTIS, PC A13/MF A01 - GPO; 1 (GPO Dep.)	E 1.99: DE86014788	MN -98E	11:46015
0473(85)	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	E 1.99: DE86014787	MN -98E	11:45990
DOE/ER-0289	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86014211	MN -11	11:46700
DOE/ER/02853-29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013356	MN -34C	11:46985
30	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013355	MN -34C	11:46986
DOE/ER/03992-554	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014632	MN -34D	11:46862
578	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014621	MN -34D	11:46863
DOE/ER/10229-23	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014352	MN -80	11:45893
DOE/ER/10719-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014252	MN -34B	11:46770
DOE/ER/10759-6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013985	MN -28	11:46447
DOE/ER/13124-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013986	MN -11	11:46752
DOE/ER/30063-H2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE86013158	MN -96	11:46077
DOE/ER/40048-26-N6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014282	MN -34D	11:46893
29-N6	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014284	MN -34D	11:46864
162	NTIS, PC A02/MF A01; 1	DE86013147	MN -34C	11:46974
163-L6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013146	MN -34D	11:46838
171-L6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014378	MN -34	11:46771
DOE/ER/40233-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013957	MN -34D	11:46865
DOE/ER/45097-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86009224	MN -25	11:46170
DOE/ER/45142-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013658	MN -25	11:46118
DOE/ER/45144-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86013958	MN -34D	11:46866
DOE/ER/45151-2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014684	MN -25	11:46197
DOE/ER/45182-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014348	MN -25	11:46132
DOE/ER/53188-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86014243	MN -20d	11:46797
DOE/ER/53222-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86013666	MN -20	11:47036
DOE/ER/60246-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86011485	MN -11	11:46670
DOE/ER/60376-12b	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86013057	MN -11	11:46753
DOE/ER/60393-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014680	MN -48	11:46707
DOE/ER/60397-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014035	MN -11	11:46642
DOE/ER/60402-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86013991	STD -48	11:46708
DOE/ER/60415-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE86014677	MN -34	11:46821
DOE/ET-11448-T1	NTIS$16.50			11:45993
20009-T1	NTIS$19.50			11:45744
DOE/ET/13011-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE86013983	MN -90e	11:45641
DOE/ET/29078-T2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014715	MN -48	11:46751
DOE/ET/29201-T1	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99: DE86012297	STD -97a	11:45841
DOE/ET/53088-2	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014687	MN -20	11:47037
230	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014389	MN -20	11:47038

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239	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014391	MN -20	11:47040
240	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014392	MN -20	11:47041
244	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014393	MN -20a	11:47042
DOE/EV/03139-51	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014663	MN -48	11:46737
DOE/EV/03333-T6	MIT, 77 Massachusetts Ave., Cambridge, MA 02139		TI86012565	ND -48	11:46689
T8	Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA 02139		TI86012566	ND -48	11:47008
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2009-Vol.3	NTIS, PC A20/MF A01; 1 (GPO Dep.)	E 1.99:	DE86006612	MN -91	11:45698
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1005-9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010333	STD -38	11:46417
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E-2328-1	*See* N-86-24839				11:46172
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EGG-M-T-0286	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013459	MN -71	11:45711
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EPA-600/ 4-86/ 022	*See* DOE/DP/00539-056	E 1.99:	DE86014406	STD -41	11:46649
EPA-600/ 4-86-030	*See* DOE/DP/00539-057	E 1.99:	DE86014090	STD -41	11:46650
EPA/520/5-76/ 020	*See* PB-86-210531/XAB				11:45726
EPA/600/4-85/ 015	*See* PB-86-208360/XAB				11:46646
EPA/600/4-86/ 025	*See* PB-86-208709/XAB				11:46678
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4608	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920415	ND -62a	11:45798
4639	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920351	ND -60	11:45827
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4666	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920418	ND -90h	11:46133
4688	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920416	ND -90h	11:46134
4699-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920417	ND -90d	11:45629
4727	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920419	ND -90h	11:46135
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4388	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920424	ND -97a	11:45842
4522-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920422	ND -97	11:45833
4522-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920423	ND -97	11:45834
4632-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920425	ND -97c	11:46017
4632-Vol.2	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920426	ND -97c	11:46018
4729	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920427	ND -97c	11:45835
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4568	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920402	ND -38	11:46136
4599-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920430	ND -94e	11:45759
4643	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920370	ND -97b	11:45836
4722	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920429	ND -94a	11:45965
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4550	Research Reports Center, Box 50490, Palo Alto, CA 94303; 1	TI86920433	ND -78	11:45851
4551	Research Reports Center, Box 50490, Palo Alto, CA 94303; 1	TI86920436	ND -78	11:45852
4625	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920432	ND -80	11:45886
4648	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920406	ND -78	11:45853
4698	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920434	ND -78	11:45854
4705	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920435	ND -78	11:45887
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4542	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920437	ND -90	11:45837
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4649-Vol.1	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI86920438	ND -25	11:46137
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86020C	NTIS, PC A16/MF A01; 1 (GPO Dep.)	E 1.99: DE86014457	MN -59A	11:45791
86020D	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86014458	MN -59A	11:45792
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9943-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -61	11:45747
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10033-FR	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -25	11:46138
10146-IT	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -61A	11:45765
10147-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -61A	11:45766
10152-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -4	11:45742
10294-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities		ND -4	11:46225

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10352-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -98	11:45982
10353-EN-FR	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -11	11:46639
10364-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -4	11:46658
10366-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -90a	11:45623
10380-EN	Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities			ND -4	11:46226
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86/ 102-E	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014372	MN -34D	11:46839
FNAL-TM-					
1406	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014464	STD -28	11:46448
1407	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014468	STD -28	11:46434
1409	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014463	STD -28	11:46449
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0004-86	*See* AD-A-167846/5/XAB				11:46364
GA-A-					
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18454	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014028	MN -21	11:47044
18455	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014030	MN -21	11:47098
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GAT-NM-					
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7591	NTIS, PC A05/MF A01 - GPO		TI86014374	MN -78	11:45845
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285/ 21	*See* PNL-SA-13454	E 1.99:	DE86013340	MN -41	11:46730
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363	NTIS (US Sales Only), PC A10/MF A01		DE86703195	MN -37	11:46396
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IFP-RA-					
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239	*See* DOE/ET/53088-239	E 1.99:	DE86014391	MN -20	11:47040
240	*See* DOE/ET/53088-240	E 1.99:	DE86014392	MN -20	11:47041
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253/ L	NTIS (US Sales Only), PC A02/MF A01		DE86703142	MN -46	11:47001
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INDC(JPN)-					
106/ L	*See* NEANDC(J)-120/U		TI86901587	ND -34C	11:46897
107/ L	*See* NEANDC(J)-121/U		TI86901539	ND -34C	11:46981
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8	NTIS (US Sales Only), PC A03/MF A01		DE86703168	MN -71	11:45713
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10174	NTIS (US Sales Only), PC A07/MF A01		DE86703198	MN -37	11:46579
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10407	NTIS (US Sales Only), PC A09/MF A01		DE86703151	MN -34C	11:46958
10408	NTIS (US Sales Only), PC A05/MF A01		DE86703172	MN -28	11:46450
10409	NTIS (US Sales Only), PC A07/MF A01		DE86703150	MN -34C	11:46919
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535	NTIS (US Sales Only), PC A03/MF A01		DE86703148	MN -34C	11:46989
536	NTIS (US Sales Only), PC A03/MF A01		DE86703137	MN -34D	11:46848
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730	NTIS (US Sales Only), PC A02/MF A01		DE86703121	MN -20	11:46800
731	NTIS (US Sales Only), PC A02/MF A01		DE86703122	MN -20	11:46801
733	NTIS (US Sales Only), PC A04/MF A01		DE86703123	MN -20	11:47047
IPPJ-DT-					
115	NTIS (US Sales Only), PC A06/MF A01		DE86703134	MN -20	11:47099
IS-M-					
574	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86011398	MN -90d	11:45634
JAERI-M-					
84-219	NTIS (US Sales Only), PC A04/MF A01		DE86703180	MN -80	11:45884
84-237	NTIS (US Sales Only), PC A14/MF A01		DE86703190	MN -78	11:45942
85-016	NTIS (US Sales Only), PC A04/MF A01		DE86703193	MN -80	11:45895
85-021	NTIS (US Sales Only), PC A03/MF A01		DE86703194	MN -80	11:45896
85-027	NTIS (US Sales Only), PC A05/MF A01		DE86703191	MN -78	11:45943
85-029	NTIS (US Sales Only), PC A10/MF A01		DE86703184	MN -78	11:45944
85-032	NTIS (US Sales Only), PC A02/MF A01		DE86703181	MN -80	11:45889
85-034	NTIS (US Sales Only), PC A10/MF A01		DE86703182	MN -80	11:45885
85-037	NTIS (US Sales Only), PC A11/MF A01		DE86703185	MN -78	11:45945
85-053	NTIS (US Sales Only), PC A03/MF A01		DE86703158	MN -25	11:46147
85-054	NTIS (US Sales Only), PC A02/MF A01		DE86703192	MN -77	11:45858
86-080	*See* NEANDC(J)-120/U		TI86901587	ND -34C	11:46897
86-086	*See* NEANDC(J)-121/U		TI86901539	ND -34C	11:46981
K/TS-					
11-771	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014373	MN -25	11:46618
KAPL-					
4193	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86009673	STD -32	11:46600
KEK-					
84-13	NTIS (US Sales Only), PC A06/MF A01		DE86703177	MN -28	11:46452
KU-HCOE-FL2-R-					
85-27	NTIS (US Sales Only), PC A02/MF A01		DE86752094	MN -34A	11:46802
L-					
16074	*See* N-86-25429				11:46329
16103	*See* N-86-24962				11:45690
LA-					
154/ 86	*See* OEFZS-4356			ND -11	11:46655
10634-MS	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86013629	STD -66a	11:45802
10663-MS	*See* NUREG/CR-4526		TI86010876	MN -77	11:45859
LA-UR-					
86-1076	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86008757	MN -38	11:46337
86-1404	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010198	MN -66	11:45804
86-1481	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86010207	MN -13	11:47128
86-1596	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86011258	MN -11	11:46705
86-2009	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86012374	MN -66a	11:45803
86-2139	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86012399	MN -34C	11:46904
86-2181	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86012441	MN -4	11:46307
86-2299	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013858	MN -20f	11:47100
86-2350	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013854	MN -34B	11:46776
86-2352	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013853	MN -38	11:46338
86-2369	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013852	MN -34	11:46803
86-2371	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013851	MN -38	11:46339
86-2372	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013850	MN -38	11:46398
86-2378	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013848	MN -38	11:46340
86-2379	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013847	MN -38	11:46399
86-2381	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86013846	MN -21	11:47048
86-2386	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013844	MN -34D	11:46868
86-2387	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013843	MN -38	11:46400
86-2388	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013842	MN -28	11:46455
86-2396	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013841	MN -41	11:46393
86-2412	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013839	MN -38	11:46401
86-2413	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013838	MN -38	11:46601
86-2419	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013837	MN -20f	11:47049
86-2507	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013833	MN -38	11:46341
86-2528	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013832	MN -34A	11:47012
86-2540	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013831	MN -34C	11:46859
86-2542	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013830	MN -38	11:46362
86-2590	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013825	MN -34B	11:46602
86-2636	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013821	MN -21	11:47101

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
LBL-					
11386	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013010	MN -59B	11:46031
17562	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013649	MN -59B	11:46032
20466	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013485	MN -37	11:46619
21462	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013203	MN -34C	11:46991
21536	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013190	MN -28	11:46425
21580	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013199	MN -34C	11:46976
21673	NTIS, PC AA02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013009	MN -28	11:46426
21695	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013487	MN -34D	11:46849
21716	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013472	MN -34D	11:46842
21727	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86013473	MN -66a	11:45805
MINTEK-M-					
209	NTIS (US Sales Only), PC A02/MF A01		DE86703153	MN -4	11:46238
242	*See* PB-86-208857/XAB				11:45637
MIT/BNL-					
85-3	*See* BNL-38255	E 1.99:	DE86014126	MN -90a	11:45588
MLM-					
3362	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014266	STD -4	11:46239
3363	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014265	STD -25	11:46119
MRC-TSR-					
2914	*See* AD-A-167490/2/XAB				11:46984
2917	*See* AD-A-167484/5/XAB				11:47027
MRL-R-					
983	*See* AD-A-167937/2/XAB				11:46358
986	*See* AD-A-167448/0/XAB				11:45670
N-					
86-24818	NTIS, PC A09/MF A01				11:46148
86-24836	NTIS, PC A02/MF A01				11:46171
86-24839	NTIS, PC A02/MF A01				11:46172
86-24933	NTIS, PC A10/MF A01				11:46110
86-24938	NTIS, PC A09/MF A01				11:46111
86-24961	NTIS, PC A02/MF A01				11:46328
86-24962	NTIS, PC A02/MF A01				11:45690
86-25003	NTIS, PC A09/MF A01				11:46112
86-25039	NTIS, PC A02/MF A01				11:45966
86-25046	NTIS, PC A02/MF A01				11:45967
86-25070	NTIS, PC A04/MF A01				11:46790
86-25267	NTIS, PC A02/MF A01				11:46173
86-25284	NTIS, PC A02/MF A01				11:46190
86-25305	NTIS, PC A07/MF A01				11:46342
86-25307	NTIS, PC A08/MF A01				11:46777
86-25316	NTIS, PC A02/MF A01				11:46778
86-25420	NTIS, PC A02/MF A01				11:46179
86-25429	NTIS, PC A03/MF A01				11:46329
86-25431	NTIS, PC A02/MF A01				11:46330
86-25453	NTIS, PC A03/MF A01				11:46149
86-25473	NTIS, PC A03/MF A01				11:46198
86-25476	NTIS, PC A02/MF A01				11:46113
86-25911	NTIS, PC A07/MF A01				11:46644
86-26263	NTIS, PC A02/MF A01				11:46779
86-26266	NTIS, PC A02/MF A01				11:46780
86-26270	NTIS, PC A05/MF A01				11:46781
NAC-					
83-02	NTIS (US Sales Only), PC A02/MF A01		DE86703173	MN -28	11:46456
83-03	NTIS (US Sales Only), PC A02/MF A01		DE86703174	MN -28	11:46457
83-07	NTIS (US Sales Only), PC A02/MF A01		DE86703175	MN -28	11:46458
83-08	NTIS (US Sales Only), PC A02/MF A01		DE86703171	MN -28	11:46459
84-08	NTIS (US Sales Only), PC A02/MF A01		DE86703170	MN -28	11:46435
84-15	NTIS (US Sales Only), PC A02/MF A01		DE86703176	MN -28	11:46460
NASA-CR-					
174815	*See* N-86-25046				11:45967
174884	*See* N-86-24938				11:46111
174952	*See* N-86-25003				11:46112
175048	*See* N-86-24818				11:46148
175090	*See* DOE/NASA-0005-3		TI86013617	STD -60	11:45821
176764	*See* N-86-24933				11:46110
176775	*See* N-86-25070				11:46790
176788	*See* N-86-26270				11:46781
176819	*See* N-86-26266				11:46780
176825	*See* N-86-26263				11:46779
NASA-RP-					
1155	*See* N-86-25307				11:46777
1162	*See* N-86-25911				11:46644
NASA-TM-					
77927	*See* N-86-25420				11:46179
86543	*See* N-86-25305				11:46342
86864-REV	*See* N-86-24839				11:46172
87090	*See* N-86-25284				11:46190
87243	*See* N-86-24836				11:46171
87267	*See* N-86-25476				11:46113
87269	*See* N-86-25267				11:46173
87283	*See* N-86-25039				11:45966
87286	*See* N-86-24961				11:46328
87290	*See* N-86-25453				11:46149

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
87300	*See* N-86-25473			11:46198
87305	*See* DOE/NASA-1005-9	E 1.99: DE86010333	STD -38	11:46417
87312	*See* N-86-25431			11:46330
87642	*See* N-86-25429			11:46329
88659	*See* N-86-25316			11:46778
NASA-TP-				
2582	*See* N-86-24962			11:45690
NBSIR-				
86-3050	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99: DE86014006	STD -20b	11:47102
NE-F-				
3-42-7-86	N.S.M.C., Box Y, Oak Ridge, TN 37831	TI86013424	STD -11	11:46343
3-43-7-86	Nuclear Standards Management Center, Box Y, Oak Ridge, TN 37831	TI86013422	STD -11	11:46344
3-44-7-86	N.S.M.C., Box Y, Oak Ridge, TN 37831	TI86013388	STD -11	11:46345
NEANDC(J)-				
120/ U	JAERI, Tokai-mura, Naka-gun, Ibaraki-ken 319-11, Japan	TI86901587	ND -34C	11:46897
121/ U	Japan Atomic Energy Research Institute, Dept. of Technical Information, Tokaimura, NaKa-gun, Japan	TI86901539	ND -34C	11:46981
NIKHEF-H-				
85-12	NTIS (US Sales Only), PC A02/MF A01	DE86703108	MN -34D	11:46869
NIPER-				
101	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE86014738	MN -92	11:45755
178	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014656	MN -92	11:45673
NMERDI-				
2-73-4633	NTIS, PC A06/MF A01 - NMERDI - Univ. of New Mexico, Suite M, 457 Washington SE, Albuquerque, NM 87108; 1	DE86901564	MN -61	11:45743
NMRDI-				
2-73-4220	NTIS, PC A05/MF A01 - NMERDI, Univ. of New Mexico, 457 Washington, S.E., Albuquerque, NM 87108	DE86901583	MN -60	11:45816
NP-				
6901586	School of Mines and Energy Development, Univ. of Alabama, Tuscaloosa, AL 35486	TI86901586	MN -92	11:45651
NRL-MR-				
5759	*See* AD-A-167849/9/XAB			11:47031
5769	*See* AD-A-167804/4/XAB			11:47030
5776	*See* AD-A-168008/1/XAB			11:46820
NUREG-				
0853-Suppl.6	NTIS, PC A13/MF A01 - GPO	TI86901608	MN -78	11:45946
1048-Suppl.6	NTIS, PC A05/MF A01 - GPO	TI86901577	MN -41	11:45947
1202	NTIS, PC A22/MF A01 - GPO	TI86901612	MN -78	11:45846
NUREG/CR-				
3262-Vol.2	NTIS, PC A04/MF A01 - GPO	TI86010442	MN -80	11:45948
3585-Vol.2	NTIS, PC A08/MF A01 - GPO	TI86901613	MN -70B	11:45733
4255-Vol.3-No.1	NTIS, PC A03/MF A01 - GPO	TI86012504	MN -78	11:45949
4367-Rev.1	NTIS, PC A04/MF A01 - GPO	TI86014238	MN -80	11:45847
4503-Vol.1	NTIS, PC A03/MF A01 - GPO	TI86007561	MN -78	11:45848
4526	NTIS, PC A03/MF A01 - GPO	TI86010876	MN -77	11:45859
4532-Vol.1	NTIS, PC A03/MF A01 - GPO	TI86901610	MN -80	11:45890
4532-Vol.2	NTIS, PC A09/MF A01 - GPO	TI86901611	MN -80	11:45891
4587	NTIS, PC A12/MF A01 - GPO	TI86901596	MN -80	11:45950
4624-Vol.1	NTIS, PC A11/MF A01 - GPO	TI86901592	MN -11	11:45951
4624-Vol.2	NTIS, PC A10/MF A01 - GPO	TI86901593	MN -11	11:45952
4624-Vol.3	NTIS, PC A05/MF A01 - GPO	TI86901589	MN -11	11:45953
4624-Vol.4	NTIS, PC A08/MF A01 - GPO	TI86901590	MN -11	11:45954
4624-Vol.5	NTIS, PC A08/MF A01 - GPO	TI86901591	MN -11	11:45955
NVO-				
232-Rev.3	NTIS, PC A14/MF A01; 1 (GPO Dep.)	E 1.99: DE86014101	MN -41	11:46713
OEFZS-				
4356	Special print from Bodenkultur (February 1986) v. 37(1) p. 1-6		ND -11	11:46655
OEFZS-A-				
0686	Institute for Biology, OEFZS, A-2444 Seibersdorf, Austria		ND -48	11:46694
0756	Institute for Biology, OEFZS, A-2444 Seibersdorf, Austria		ND -23	11:46729
ORAU-				
262	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86014201	MN -2	11:45986
ORNL-				
6208/ R1	*See* NUREG/CR-4367-Rev.1	TI86014238	MN -80	11:45847
6293	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86014422	MN -34	11:46804
6296	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86013815	MN -41	11:47010
6301	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE86014397	STD -79h	11:45868
ORNL/CSD/TM-				
231	NTIS, PC AA11/MF A01; 1 (GPO Dep.)	E 1.99: DE86014418	MN -80	11:45956
ORNL/FEDC-				
86/ 3	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014400	STD -20d	11:47108
86/ 4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE86014399	STD -20d	11:47109
ORNL/FETEP-				
14	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE86014411	STD -90d	11:45611
ORNL/FMP-				
86/ 2	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99: DE86014333	MN -90	11:45587

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
86/ 5	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86014336	MN -90	11:45612
ORNL/Sub-					
80-7979	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014417	STD -97a	11:45843
84-9009/ 2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014339	MN -25	11:46191
85-7685/ 1-11	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014410	MN -80	11:45881
ORNL/TM-					
8999	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE86013420	MN -28	11:45709
9520	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86014415	STD -20f	11:47050
9596	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014421	STD -97b	11:45844
9632-Vol.3-No.1	*See* NUREG/CR-4255-Vol.3-No.1		TI86012504	MN -78	11:45949
9678	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014408	MN -70	11:46759
9703	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86014413	STD -20f	11:47051
9889	NTIS, PC A07/MF A01 (GPO Dep.)	E 1.99:	DE86014394	MN -71	11:46346
9950	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014395	STD -86	11:46241
9964	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014340	MN -34C	11:46940
9992	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE86014409	MN -20	11:47110
10002	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE86014420	MN -70	11:45725
10034	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014402	MN -32	11:47019
10066	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014414	MN -90d	11:45613
10071	NTIS, PC A06/MF A01 (GPO Dep.)	E 1.99:	DE86014412	STD -80	11:45882
10094	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86014338	MN -78	11:45957
ORNL/tr-					
86/ 28	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE86013997	MN -4	11:46318
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4,596,933					11:46608
4,597,360					11:45785
4,597,832					11:45770
4,598,338					11:46410
A 6-688,675		E 1.99:	DE86013776	MN -60	11:45832
A 6-708,477		E 1.99:	DE86013782	MN -37	11:46613
A 6-708,618		E 1.99:	DE86013783	MN -4	11:46288
A 6-720,328		E 1.99:	DE86013799	MN -37	11:46632
A 6-721,352		E 1.99:	DE86013802	MN -37	11:46612
A 6-723,674		E 1.99:	DE86013804	MN -20	11:46356
A 6-723,713		E 1.99:	DE86013805	MN -4	11:45758
A 6-726,564		E 1.99:	DE86013808	MN -37	11:46631
A 6-728,965		E 1.99:	DE86013865	MN -37	11:46611
A 6-728,976		E 1.99:	DE86013708	MN -37	11:46630
A 6-729,022		E 1.99:	DE86013710	MN -37	11:45762
A 6-730,529		E 1.99:	DE86013712	MN -32	11:47140
A 6-736,024		E 1.99:	DE86013718	MN -25	11:46215
A 6-736,033		E 1.99:	DE86013719	MN -28	11:46466
A 6-736,164		E 1.99:	DE86013722	MN -38	11:46412
A 6-747,204		E 1.99:	DE86013742	MN -37	11:46629
A 6-750,123		E 1.99:	DE86013698	MN -41	11:46699
A 6-751,413		E 1.99:	DE86013695	MN -63	11:45771
A 6-756,127		E 1.99:	DE86013694	MN -37	11:46628
A 6-762,489		E 1.99:	DE86013682	MN -38	11:46354
A 6-762,649		E 1.99:	DE86013683	MN -38	11:46355
A 6-766,168		E 1.99:	DE86013675	MN -37	11:46627
A 6-768,080		E 1.99:	DE86013746	MN -37	11:46610
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